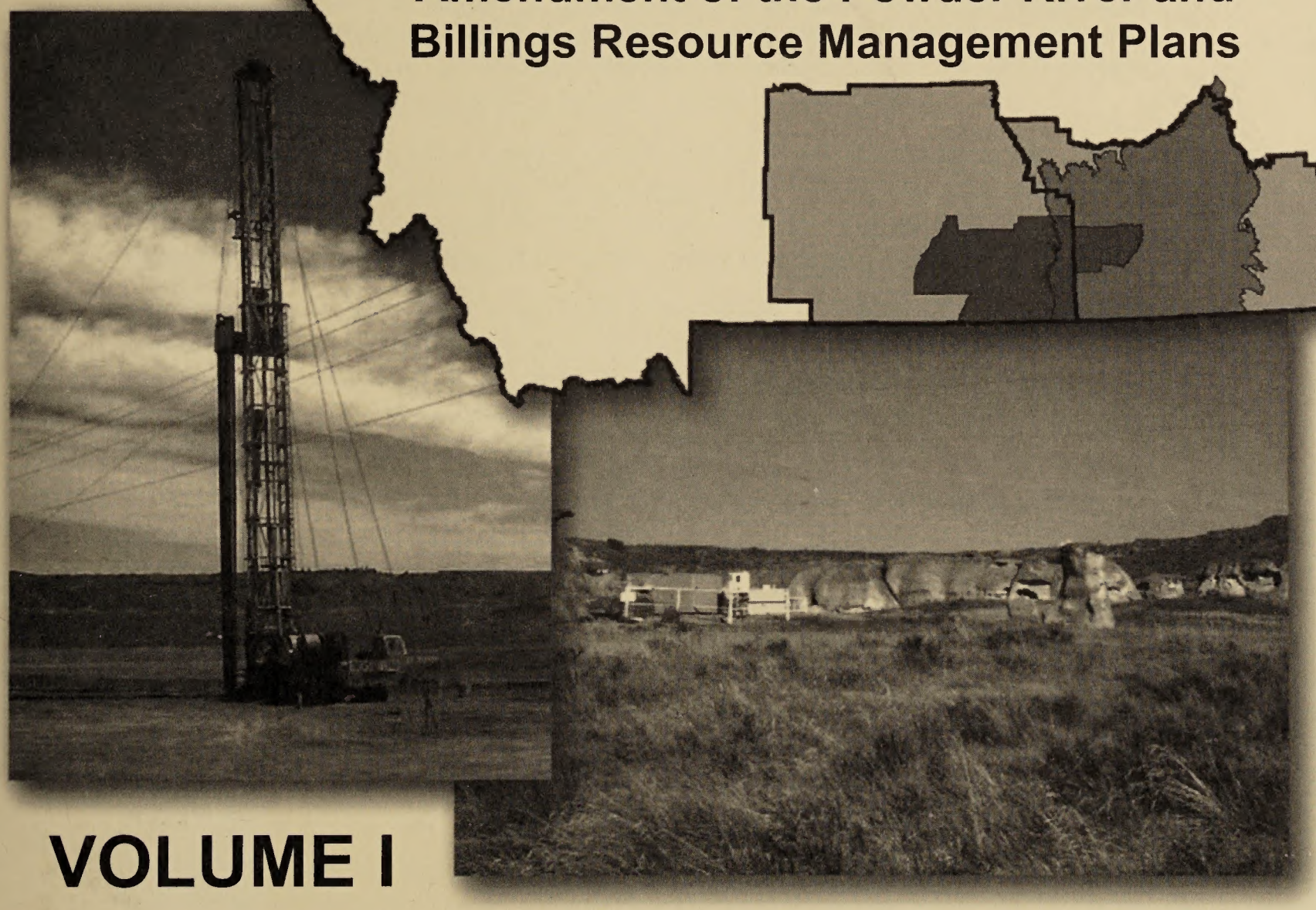
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Final Supplement to the Montana Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans



VOLUME I

October 2008

BLM

Miles City Field Office

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

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BUREAU OF LAND MANAGEMENT
Montana State Office
5001 Southgate Drive
Billings, Montana 59101-4669
http://www.blm.gov/mt

IN REPLY TO: 1610

October 10, 2008

Dear Reader:

The Bureau of Land Management (BLM) has prepared the *Final Supplement to the Montana Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans* (FSEIS). This proposed plan amendment is a result of U.S. District Court issued orders, dated February 25, 2005, and April 5, 2005, requiring BLM to prepare a Supplemental EIS to evaluate a phased development alternative for coal bed natural gas production. The U.S. District Court also advised the BLM to include the proposed Tongue River Railroad in the cumulative impact analysis and analyze the effectiveness of water well mitigation agreements.

The FSEIS is a reissue of the original BLM 2003 *Montana Statewide Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans (RMPs)* (Statewide Document). With the exception of minor edits, new text supplementing the Statewide Document is shaded gray for easy identification.

The Bureau of Indian Affairs; Crow Tribe; Department of Energy; Environmental Protection Agency; Lower Brule Sioux Tribe; Montana Board of Oil and Gas Conservation; Montana Department of Environmental Quality; U.S. Army Corps of Engineers; and Big Horn, Carbon, Golden Valley, Musselshell, Powder River, Rosebud, Treasure, and Yellowstone counties participated in the development of the SEIS as Cooperating Agencies.

The FSEIS was developed in accordance with the National Environmental Policy Act of 1969, as amended (NEPA), and the Federal Land Policy and Management Act of 1976 (FLPMA). It is based on Alternative H, the preferred alternative in the *Draft Supplement to the Montana Statewide Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans* (DSEIS), which was released on February 2, 2007; and the DSEIS *Supplemental Air Quality Analysis* which was released on December 12, 2007. The proposed land use amendment is described by Alternative H in the FSEIS. Changes between the DSEIS and FSEIS are indicated in text boxes inset at the beginning of each chapter. The FSEIS contains the effects of adopting the proposed land use plan amendment, a summary of written and verbal comments received during the public review periods on the DSEIS and the supplemented air quality analyses, and a response to comments.

The BLM has initiated activities to coordinate and consult with the Montana Governor on the FSEIS. Prior to the issuance of a record of decision and approval of the FSEIS, the Governor will be given the opportunity to identify any inconsistencies between the proposed land use plan amendment and state or local plans and to provide recommendations in writing during the 60-day consistency review period required by the BLM land use planning regulations (43 CFR 1610.3–2).

The Assistant Secretary, Land and Minerals Management, in the Department of the Interior is the responsible official for this proposed land use plan amendment. This proposed amendment is not subject to administrative review (protest) under the BLM or Departmental regulations (34 CFR 1610.5-2).

ITEM HAS BEEN DIGITIZED

FLPMA and its implementing regulations provide land use planning authority to the Secretary, as delegated to the Assistant Secretary. Because the Record of Decision is to be signed by the Assistant Secretary, Land and Minerals Management, it will be the final decision for the Department of the Interior.

As required by NEPA, the Environmental Protection Agency will publish a Notice in the *Federal Register* announcing the availability of the FSEIS. Because there is no administrative review of the decision, the Record of Decision will not be signed until at least 30 days after the Notice of Availability for the FSEIS appears in the Federal Register (see 40 CFR 1506.10[b]). The Department of the Interior will wait until the Governor's consistency review has been completed before signing and issuing the Record of Decision for the land use plan amendment.

There are a limited number of hard-copy books available upon request. If you would like a book, or have any questions, please contact the BLM Miles City Field Office at (406) 233-2800.

Sincerely,

Gene R. Terland
State Director, Montana/Dakotas

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FINAL SUPPLEMENT TO THE MONTANA STATEWIDE OIL & GAS ENVIRONMENTAL IMPACT STATEMENT AND PROPOSED AMENDMENT OF THE POWDER RIVER AND BILLINGS RESOURCE MANAGEMENT PLANS

Bureau of Land Management

October 10, 2008

Recommended by:

James M. Sparks, Billings Field Manager

Recommended by:

M. Elaine Raper, Miles City Field Manager

Approved by:

Gene R. Terland, State Director, Montana/Dakotas

ITEM HAS BEEN DIGITIZED

Final Supplement to the Montana Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans

Lead Agency: U.S. Department of the Interior, Bureau of Land Management (BLM)

Type of Action: Administrative

Jurisdiction (Planning Area): the planning area is BLM-administered lands and minerals in the Powder River Resource Management Plan (RMP) (Powder River, Carter, and Treasure counties and portions of Big Horn, Custer and Rosebud counties) and the Billings RMP (Carbon, Golden Valley, Musselshell, Stillwater, Sweet Grass, Wheatland, and Yellowstone counties and the remaining portion of Big Horn County). The planning area contains about 1,506,011 acres of federally managed surface, and 5,009,784 acres of federal mineral estate.

Abstract: As a result of lawsuits filed against the BLM's Record of Decision (ROD), the U.S. District Court issued orders, dated February 25, 2005, and April 5, 2005, that required the BLM to prepare a Supplemental Environmental Impact Statement (SEIS) to evaluate a phased development alternative for coal bed natural gas (CBNG) production. The U.S. District Court also issued an order, dated February 25, 2005, advising the BLM to include the proposed Tongue River Railroad in the cumulative impact analysis and analyze the effectiveness of water well mitigation agreements.

The Final SEIS (FSEIS) is a reissue of the original EIS/Amendment: *Montana Statewide Oil and Gas Environmental Impact Statement and Amendment of the Powder River and Billings Resource Management Plans* (Statewide Document). This SEIS provides additional information and analyses regarding the topics identified by the U.S. District Court. It is intended to expand on the information presented in the Statewide Document.

The FSEIS analyzes three phased development alternatives (F, G, and H) for managing oil and gas resources in the planning area. As a result, the BLM selected a new preferred alternative (H). This alternative would amend the Resource Management Plans and allow coal bed natural gas (CBNG) exploration and development while minimizing impacts on environmental resources.

SUMMARY

Introduction

In 2003, the Bureau of Land Management (BLM) and the State of Montana jointly prepared the Montana Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans (Statewide Document). For the BLM, the Statewide Document analyzed the environmental impacts associated with the exploration and development of oil and gas resources, including coal bed natural gas (CBNG) in the Powder River and Billings Resource Management Plan (RMP) areas. The BLM Record of Decision (ROD) for the Statewide Document, approved on April 30, 2003, amended the Powder River and Billings RMPs to change existing land use decisions regarding the development of oil and gas resources, including CBNG exploration and development.

As a result of lawsuits filed against the BLM's ROD, the U.S. District Court issued orders, dated February 25, 2005, and April 5, 2005, that required the BLM to 1) prepare a Supplemental Environmental Impact statement (SEIS) to evaluate a phased development alternative for CBNG production, 2) include the proposed Tongue River Railroad in the cumulative impact analysis and to 3) analyze the effectiveness of water well mitigation agreements.

The Final SEIS (FSEIS) provides additional information and analyses regarding the topics identified by the U.S. District Court. It is intended to expand on the information presented in the Statewide Document, not replace it. The FSEIS has been prepared according to the National Environmental Policy Act (NEPA) of 1969, as amended, and the Federal Land Policy and Management Act of 1976, as amended. It considers the three topics identified above at a programmatic planning level.

Additionally, the FSEIS updates the Statewide Document with new information and reflects any changes in policies, regulations, or activities since that document was approved. Summaries of monitoring data and the results of studies completed since the Statewide Document was finalized have been incorporated to update the public. These additions can be found in Chapter 3 under the individual resource topics as well as in appropriate appendices.

This summary discusses the following information:

- The planning area analyzed in the SEIS.
- The federal agencies responsible for preparing the SEIS.
- A brief explanation of what CBNG is and why it occurs in coal beds.
- A summary of the purpose of and need for the SEIS.
- An explanation of how the SEIS conforms with the Powder River and Billings RMPs.
- A description of the environmental issues discussed in Chapters 3, 4, and 5 of the SEIS.

The Planning Area

The planning area for the SEIS encompasses the BLM-administered lands and minerals in the Powder River and Billings RMP areas (Map 1-1). The planning area excludes those lands administered by other agencies such as the Forest Service; and sovereign tribal governments, such as the Crow Tribe of Indians, and the Northern Cheyenne Tribe. Indian allotted lands are also excluded from the planning area. The BLM will make oil and gas decisions based on the Statewide Document and this SEIS for the oil and gas estate it administers within the Powder River and Billings RMP areas. See the location map on the next page.

Preparers of the SEIS

The BLM is the lead agency responsible for preparing the SEIS. The information and proposed decisions discussed in the plan are not final until the BLM signs a ROD. The ROD will be signed no sooner than 30 days after the FSEIS is published. The BLM will take any protests into account before signing the ROD.

What does the Summary Include?

The sections in this summary are the same as the five major chapters within the FSEIS. In most cases, second-level headings in the summary cover the same information as the same headings in the Draft SEIS (DSEIS). Readers of this summary with questions should go to the parallel chapter or section in the FSEIS.

The following cooperating agencies and tribes assisted the BLM in the preparation of the DSEIS:

- U.S. Environmental Protection Agency (EPA)
- Department of Energy (DOE)
- Bureau of Indian Affairs (BIA)
- U.S. Army Corps of Engineers (USACE)
- Montana Department of Environmental Quality (MDEQ)
- Montana Board of Oil and Gas Conservation (MBOGC)
- Lower Brule Sioux Tribe
- Crow Tribe of Indians
- Commissioners from the following counties: Big Horn, Carbon, Golden Valley, Musselshell, Powder River, Rosebud, Treasure, and Yellowstone.

The Northern Cheyenne Tribe has also commented on the development of the SEIS.

The cooperators' assistance included the submission of technical information and frequent consultation meetings with the BLM to discuss issues and concerns along with possible mitigation measures. The cooperators may use or reference the SEIS for their future actions.

Coal Bed Natural Gas

CBNG is a natural hydrocarbon gas, primarily methane (CH_4) that occurs in beds of coal. Coal beds developed when dead plant material collected in ancient swamps and bogs. Once preserved and covered by soil and rocks, the plant material began to decay and to lose water, becoming more compact and dense, and its temperature began to increase. Over thousands of years, these natural processes ultimately produced various types of coal. Methane is usually found in sub-bituminous and bituminous coals.

CBNG exploratory wells are drilled in an attempt to find viable commercial quantities of trapped methane. If the CBNG exploratory wells are successful, additional wells are drilled to produce the methane by bringing it to the surface where it is processed and transported through pipelines to markets. Currently, the only methane production in Montana is from approximately 555 wells at the CX Field and a few other fields near Decker, Montana.

Chapter 1: Purpose and Need

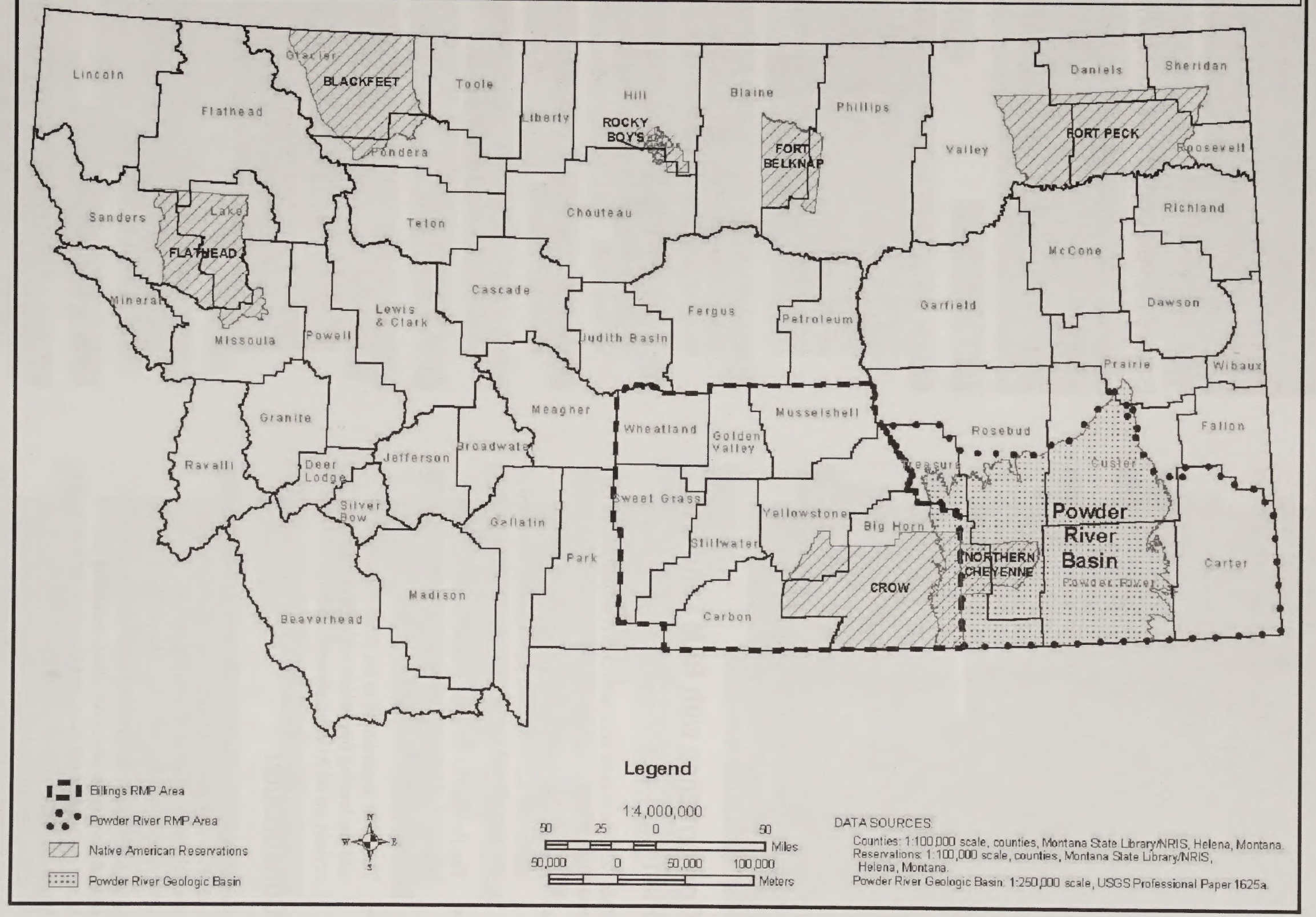
The BLM and the State of Montana were co-leads for preparation of the Statewide Document. The BLM is responsible for managing federally owned oil and gas resources. For the BLM, the purpose of the Statewide Document was to analyze impacts from oil and gas activity, including CBNG exploration, production, development, and reclamation in the Powder River and Billings RMP areas. The EIS was used to analyze options for the BLM to change its planning decision by considering oil and gas management options, including mitigating measures that will help address the environmental and social impacts related to CBNG activities.

The analysis in the Statewide Document focused on oil and gas development issues not covered in the 1994 and previous RMPs, such as water management from CBNG production. The alternatives provided a range of management options for amending the RMPs. The preferred alternative (Alternative E) was BLM's proposed and selected RMP amendment.

For the State of Montana, the purpose of the Statewide Document was to support the state's development of a program to address CBNG exploration, development, production, and reclamation in Montana. The Statewide Document, in part, responded to the stipulation and settlement agreement, dated June 19, 2000, resulting from a lawsuit brought by the Northern Plains Resource Council challenging the MBOGC in the Montana First Judicial District Court, Lewis and Clark County.

The BLM published the original Notice of Intent for the Statewide Document in the *Federal Register* on December 19, 2000. The BLM published the Notice of Availability in the Federal Register on January 17, 2003. Immediately following approval of the ROD on April 30, 2003, several lawsuits were filed against the BLM's decision in the U.S. District Court. The U.S. District Court issued orders, dated February 25, 2005, and April 5, 2005, that required the BLM to prepare an SEIS to evaluate a phased development alternative for CBNG production. The U.S. District Court also advised the BLM to include the proposed Tongue River Railroad in the cumulative impact analysis and to analyze the effectiveness of water well mitigation agreements.

Map S-1: Planning Area - Billings and Powder River RMP Areas



This SEIS addresses the three topics identified by the U.S. District Court. For the evaluation of CBNG phased development, this document will analyze the direct, indirect, and cumulative environmental and social impacts of phased development alternatives based on issues identified by the U.S. District Court, cooperating agencies, and public scoping comments. These phased development alternatives, coupled with the alternatives presented in the Statewide Document, will provide a range of management options for amending the Powder River and Billings RMPs to address CBNG development. The SEIS impact analysis in Chapter 4 will also include the cumulative impacts from the proposed Tongue River Railroad and will address the effectiveness of water well mitigation agreements, as required under 85-11-175, Montana Code Annotated (MCA).

This SEIS updates the description of the Affected Environment (Chapter 3) and the Environmental Consequences (Chapter 4) presented in the Statewide Document with relevant new information and reflects any changes in policies, regulations, or activities since that document was approved. Summaries of monitoring data and the results of studies completed since the Statewide Document was finalized have been incorporated to update the public.

Conformance with BLM Land Use Plans

This SEIS considers alternatives that would amend the two BLM RMPs:

- The Billings RMP issued by BLM on September 28, 1984, and subsequently amended to consider oil and gas development in 1994
- The Powder River RMP issued by the BLM on March 15, 1985, and subsequently amended for oil and gas in 1994
- The 1994 amendment to the RMPs analyzed oil and gas leasing operations and management actions on BLM administered lands.

Consultation

As part of the scoping effort, BLM consulted with the U.S. Fish and Wildlife Service (FWS), regarding analysis in the SEIS and compliance with the Endangered Species Act.

In addition to the cooperating agencies, a number of state departments were consulted, including the Montana Bureau of Mines and Geology (MBMG), the Montana Fish, Wildlife and Parks (MFWP), the Montana Department of Natural Resources and Conservation (DNRC), and the Montana State Historic Preservation Office (SHPO).

Finally, consultation included meetings with the three Native American tribes. The Crow Tribe of Indians and the Northern Cheyenne Tribe have land in the planning area. The Lower Brule Sioux Tribe has areas of historic use within the planning area. The BLM has met with these Tribes several times to discuss their concerns about CBNG development.

Issues Developed During Scoping

The following issues were identified from the public scoping process held during August and September 2005. The issues raised were in relation to CBNG phased development. Note, these issues have been expressed in the form of questions.

Air Quality/Climate

- How will air quality, including visibility, be protected and mitigated, especially when considering all existing and proposed sources within the region? Concerns include general air quality, visibility, and potential adverse effects to public health from cumulative emissions of fine particles and fine particle precursors.
- How will air quality, including visibility be protected within the Northern Cheyenne Indian Reservation airshed and other Class I airsheds?
- How will impacts on water chemistry in high altitude lakes with little acid neutralizing capacity be prevented?
- How will potential for fires from the migration of methane be avoided?
- What additional impacts will the Tongue River Railroad have on regional air quality?

Cultural Resources

- How will culturally important springs and other traditional cultural properties be affected and protected? These include all traditional cultural properties identified by the Northern Cheyenne Tribe as important such as the Rosebud and Wolf Mountains Battlefield sites and Northern Cheyenne Homestead sites in the Tongue River Valley.
- What traditional cultural properties in the RMP areas may be affected by CBNG development and how will they be managed?

Native American Concerns

- How will unique environmental, social, economic, and cultural impacts to Native Americans be addressed by phased development?

- How will phased development provide an economic base to benefit tribal members, while not leading to another boom-and-bust cycle?
- How will subsistence hunting, fishing, and gathering be affected and protected?
- How will phased development help BLM to fulfill its Native American treaty trust obligations?
- How will phased development provide protection to tribal reserved water rights?
- How will phased development include coordination and consultation with tribal representatives?

Oil and Gas

- How will phased development be structured to address the national supply and demand situation and reduce the United States' dependence on foreign energy resources?
- How will RMP- or landscape-scale effects be addressed by phased development?
- How will lease stipulations be used to mitigate for effects from phased development?
- How will phased development be structured to minimize infrastructure development (to reduce both costs and impacts), including coordination with neighboring landowners?
- How will reclamation and restoration be addressed by phased development?

Phased Development

- How will be phased development be planned to account for and protect other resources?
- How will resource impacts from development and other CBNG activities be evaluated and addressed throughout the implementation of phased development?
- How will phased development minimize fluctuations in populations, air quality impacts, overburdening of infrastructure and services, and increases in secondary development?
- How will drainage of federal gas resources and impacts to federal lessees be addressed or affected by phased development?
- What phased development implementation strategy or strategies will be included (e.g., restrictions on location [specific area or coal seam], timing, or number of wells)?
- Will more than one phased development alternative be addressed in the SEIS/Amendment?
- How will phased development reduce impacts, improve mitigation options, or protect multiple-use of resources?

Socioeconomics

- How will social and cultural changes be addressed by phased development? Specific concerns included infrastructure and service costs borne by state, local, and tribal governments, increased population, social pathologies (e.g. crime, alcoholism, drug use) and environmental exploitation.
- How will revenues (income lessees and state and local taxes) be affected by phased development, and how will these effects differ for reservation and off-reservation communities?
- How will phased development affect jobs, job security, local economy, and farming and ranching activities, and how will these effects differ for reservation and off-reservation communities?

Vegetation

- How will phased development address impacts to and the reclamation of sagebrush steppe and grassland ecosystems?
- How will phased development account for the relatively slow vegetative response to changes in groundwater or surface water characteristics?
- How will phased development address the spread of non-native species in affected areas?
- How will phased development affect medicinal and ceremonial native plants important to Native Americans?

Water Resources

- How will produced water be managed by phased development?
- How will groundwater impacts be addressed by phased development? Concerns include groundwater drawdown in area or neighboring aquifers, effects on drinking water and stock watering wells, natural springs, and approved water rights.
- How will phased development address surface water effects and mitigation? Concerns include the consequences of changing surface water quality and transforming ephemeral or intermittent streams into perennial water bodies.

- How will effects from development outside the planning area be addressed by phased development?
- How will water well mitigation agreements mitigate the effects of aquifer drawdown and methane migration?
- How will phased development affect surface and groundwater quality?

Wildlife

- How will phased development address impacts on wildlife (particularly fish and other aquatic species) and habitat from changes to water quality?
- How will phased development address impacts (both site-specific and at the RMP, landscape, or ecosystem scale) to terrestrial wildlife species (and associated habitats), including song birds, burrowing owls, and bald eagles, but especially sage grouse and prairie dogs? Particular concerns included habitat fragmentation and cumulative effects from development outside the planning area and the ability to assign and quantify impacts from various anthropogenic influences.
- How will phased development address potential effects on big game and other subsistence wildlife populations relative to tribal hunting and fishing rights?
- How will phased development affect ESA-listed or potentially listed ESA species?

Data Gaps

The SEIS incorporates relevant new data collected since the spring of 2002 to update information presented in the Statewide Document, as needed to meet the requirements of the Court's decision. The BLM incorporated this new data to address the topics identified by the Court and during public scoping, to evaluate project effects from phased development alternatives, and to analyze significant new environmental information relevant to environmental concerns that have a bearing on alternatives or their impacts.

Chapter 2: Alternatives

The SEIS presents eight alternatives that describe and analyze different actions regarding the management of CBNG activities. The No Action Alternative describes and analyzes current management of CBNG activities by BLM and the State while the other seven alternatives describe and analyze other management actions including phased development that provide different methods of protection to other resources and land uses from CBNG activities. The eight alternatives analyzed in detail are described briefly below.

Alternatives Considered

Alternative A—No Action (Existing CBNG Management)

BLM would continue to review and approve APDs for conventional oil and gas and for CBNG wells in accordance with the 1994 Oil and Gas Amendment.

Approved APDs would include only CBNG exploration wells, not production wells. The State would conduct its permitting process by complying with the Stipulation and Settlement Agreement dated June 19, 2000. Under this agreement, the State can approve up to a maximum of 325 producing wells in the CX Field and 200 exploratory CBNG wells throughout the rest of the state.

Alternative B—CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife, and Cultural Resources

BLM and the State would review and approve CBNG activities with an emphasis on resource protection. BLM and the State would use stringent mitigation measures to minimize or eliminate adverse impacts to other resources. Examples of such mitigation measures would include requiring the injection of water produced with CBNG and requiring all compressors to be fueled by natural gas rather than by diesel or electricity.

Alternative C—Emphasize CBNG Development

BLM and the State would review and approve CBNG activities with an emphasis on facilitating production of CBNG. BLM and the State would use the least restrictive mitigation measures to minimize or eliminate adverse impacts to other resources. Examples of such measures would be to authorize the discharge of water produced with CBNG onto the ground or into the water bodies when the discharge water meets applicable standards. Compressors could be fueled by gas, diesel, electricity, or other means as long as other permitting standards, such as air quality, are met.

Alternative D—Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

BLM and the State would review and approve CBNG activities with an emphasis on maintaining or enhancing land uses in combination with CBNG development. BLM and the State would use mitigation measures, as much as possible, that compliment the needs of land owners and other lessees. Management of water produced with CBNG would be greatly influenced by the surface owner. The water could be made available for beneficial uses or may be required to be reinjected. Location of facilities, such as compressors, would be influenced by the needs of the landowner.

Alternative E—Allow CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

BLM and the State would review and approve CBNG activities in a manner that facilitates efficient and orderly CBNG activities while providing the appropriate type of resource protection on a site specific basis as well as an ecosystem basis. Different management actions, such as discharge, impoundment, reinjection or beneficial use, would be applied to water produced with CBNG. Likewise, different management actions such as location, size, and mufflers (as required) would be applied to compressors. Also, realty questions, such as the handling of surface disturbance, would be handled by requiring the operator to consult with the owner of the surface rights.

The State chose this alternative as their Preferred in 2003 and issued a ROD based on this approach.

Alternative F – Phased Development Multiple Screens (High Range)

Under this alternative, development of CBNG on federal leases in the Billings and Powder River RMP areas would be done in a phased manner through restrictions imposed by the BLM. The BLM would limit the number of federal applications for permit to drill (APD) approved each year (910) cumulatively (both state and federal APDs combined) and in each fourth order watershed. BLM would also limit the percentage of disturbance on BLM surface or on private surface overlying federal minerals within each identified crucial habitat polygon. Furthermore, conditions would be placed on any proposed federal CBNG development within crucial sage-grouse habitat areas with the goal of avoiding displacement of sage-grouse from crucial habitat areas. BLM would place a limit on the volume of untreated water discharged to surface waters from federal CBNG wells within each fourth order watershed. The fourth order watershed level was adopted for this alternative because it provides a geographic perspective consistent with the analysis completed for the 2003 FEIS and is appropriate for the SEIS analysis.

Exploration and development of CBNG resources on BLM-administered minerals would also be subject to a Reservation buffer (5 miles), an evaluation of water management options, POD requirements, State and federal permits, and lease stipulations.

Alternative G – Phased Development Multiple Screens (Low Range)

Under this alternative, development of CBNG on federal leases in the Billings and Powder River RMP areas would be done following the same management actions as described under Alternative F; however, development would be limited to the low range of predicted wells (6,470) from the RFD (325 per year). Therefore, the following would be applied under Alternative G:

- Annual cumulative limit (5 percent or 325 APDs/year)
- Fourth order watershed rate of development
- Wildlife habitat (20 percent over 20 years)
- Crucial Sage-grouse habitat conditions
- Untreated produced water (10 percent of 7Q10) thresholds
- Reservation buffer distance (5 miles)
- Principles of adaptive management
- Plan of development (POD) requirements
- State and federal permits, and lease stipulations
- Discussion of a range of water management options

The low range of development, as described in the reasonably foreseeable development (RFD) scenario, was developed following the same assumptions as the high range.

Alternative H – Preferred Alternative - Multiple Screens

Alternative H is the BLM's preferred alternative for the development of CBNG resources on BLM-administered lands. Mitigation measures and screens in this alternative would be applied to BLM administered mineral estate.

Alternative H has three key components. First, a phased development approach would be implemented where CBNG proposals would be reviewed against four filters or screens to determine if the proposal needs to be modified. Second, this alternative would include extensive requirements that an operator must meet when submitting a POD. Third, mitigation measures would be considered and applied to each POD, as appropriate.

The review screens would be applied to water resources, wildlife, Native American concerns, and air resources. The screens would be implemented to monitor impacts and develop a decision-making process that could control and reduce impacts before authorizing the action. The phased approach is intended to reduce the overall cumulative impacts to any resource by managing the pace of development. Reduced development rates may extend the overall time required for extraction of the CBNG resources. Such reductions might be one outcome of the phased development approach. No restrictions on the pace of development may occur if POD submittals were slower than anticipated, or if monitoring data indicates that additional impacts to resources are being mitigated. In other words, full-field development may be allowed if each POD passed the four screens and sufficient monitoring data were available to evaluate each POD against the four screens.

Exploration and development of CBNG resources on BLM-administered minerals would be subject to agency decisions, lease stipulations, permit requirements, and surface owner agreements.

Chapter 3: Affected Environment

This chapter in the SEIS does not present impacts. It describes what is currently present or happening within the counties being analyzed.

The affected environment includes the physical, biological, social, and economic resources that the alternatives could impact. For the BLM, these resources are in two resource planning areas located in south-central and southeastern Montana. Several federally recognized Indian tribes own land within the RMP areas analyzed in the SEIS. These tribal governments include the Crow Tribe of Indians, the Northern Cheyenne Tribe, The Lower Brule Sioux Tribe, and the North Dakota Turtle Mountain Tribe. Their land holdings are an important share of the planning area:

- The Crow Reservation comprises nearly 2,296,000 acres in south-central Montana.
- The Northern Cheyenne Reservation comprises about 445,000 acres in southeastern Montana, and lies just east of the Crow Reservation.
- The North Dakota Turtle Mountain Tribe has approximately 61,250 acres of federal trust lands allotted to their members, which are scattered throughout the emphasis area.
- The Lower Brule Sioux Tribe has also contacted BLM about the allotted lands held in trust by the federal government in the emphasis area, along with numerous traditional cultural sites.

These Native American land holdings share many of the same resource values as those summarized below for the planning area.

Resources in the emphasis area are described in the SEIS based on the scope and intensity of the potential impacts. The following bullet points highlight the existing resource conditions. For more information about the resources in the study area, see Chapter 3 in the SEIS.

- Air quality is generally very good, based on few industrial emission sources and on scattered residences in small communities and isolated ranches.
- The area is rich in cultural resources, especially historic sites, including fur trading posts, homesteads, emigrant and stage trails, Indian war battle sites, ranch centers, and many Native American sites (the use of which continued well into the historic period).
- Minerals include uranium, gold, silver, gypsum, vanadium, and bentonite. Oil and gas resources are scattered across the analysis area. Extensive coal beds are an especially important resource in south-central and southeastern Montana.
- Surface water is the primary water source for Montana users. The quality of surface water is generally good to fair, but some problems with salinity occur during periods of low flow. Groundwater is a minor source of usable water, however in some areas groundwater is the only source of water for domestic stock use. Groundwater quality is sometimes a problem, often making it unsuitable for irrigation; however it typically meets standards for domestic and stock use.

- Indian trust assets include lands, timber, water resources, other natural resources, and assets held in trust by the U.S. government for Indian tribes and individual Indians.

- Livestock grazing is an important economic activity. The planning area includes some 1,205 federal grazing allotments, covering about 1.6 million acres of federal land.

- Recreation is an increasingly important feature of the Montana economy. Large areas of federal and state land are dedicated to recreation, including land for fishing, hunting, hiking, photography, wildlife viewing, water sports, off-road vehicle activities, camping, touring, and caving.

- Population within the planning areas is increasing at an average annual rate of 1.1 percent. Socio-economic data from the 2000 census shows a total population of about 238,760 people in the planning area. These residents, along with the many thousands who annually visit and use Montana resources, are important contributors to the overall health of the Montana economy.

- Socio-economic data includes the per capita income figure for the planning area: $17,427. The statewide per capita figure was $21,229, while the total U.S. figure was $27,203. Per capita income has been increasing in the planning area at roughly a 5.2 percent annual rate.

- Vegetation varies within a wide range of plant communities: grasslands, shrublands, forests, and riparian areas.

- Visual resources in the analysis area are diverse and of high importance, both to residents and to the many visitors to Montana.

- Wildlife include mammals such as elk, mule deer, white-tailed deer, and pronghorn; bird species, including waterfowl, raptors, and songbirds (many of which are neotropical migrants); reptiles and amphibians; and many species are either listed for protection or are of special management concern, including sage grouse, mountain plover, prairie dogs, gray wolf, Canada lynx, and the grizzly bear.

Chapter 4: Environmental Consequences

This chapter of the SEIS presents the scientific and analytical information that supports conclusions about the potential impacts of the alternatives analyzed.

The resource impacts summarized in this section focus on the most important impacts of Alternative H—Preferred CBNG Development Alternative.

Alternative H is the one that the BLM currently consider to be "preferred" (that is, the alternative that the BLM will likely select in their respective RODs following issuance of the FSEIS).

Resources with Low Intensity Impacts

Potential impacts on some resources are of low intensity and do not change much, if at all, among alternatives. Impacts of this sort do not help readers distinguish between alternatives.

This similarity among alternatives occurs because the alternatives are programmatic in nature. Programmatic alternatives do not and cannot reflect actual conditions at specific sites. The APD process is used to verify that the BLM and the State have considered actual site conditions before issuing an APD. Resources with low intensity and similar impacts include the following:

- Cultural Resources
- Environmental Justice
- Geology and Minerals
- Livestock Grazing
- Paleontological Resources
- Solid and Hazardous Wastes
- Wilderness Study Areas

Resource Impacts that are Important Features of Alternative H

The following sections highlight those impacts that would help readers understand the context and intensity of the actions included in Alternative H. For more information about these impacts, see the full text of Chapter 4 in the SEIS.

Air Quality

Alternative H project emissions would not alone cause a potential violation of National or Montana Ambient Air Quality Standards (NAAQS/MAAQS) or Prevention of Significant Determination (PSD) Class I/Class II Increments. However, impacts on visibility at several (15) Class I and Class II areas, including the Northern Cheyenne, and Crow Indian Reservations, have been predicted through modeling. BLM has developed the Air Quality Screen under Alternative H to mitigate potential impacts to air resulting from project related emissions. Additionally, the air quality permitting process would be used to analyze emission sources at the project level for CBNG development. Emission sources that would violate standards would not be permitted by the agencies. Thus, the residual impacts to air quality would remain within standards.

Hydrological Resources

Surface Water

Surface water quality would be slightly altered from current water quality conditions, which are generally good. Downstream uses would not be diminished. Surface water flows moderately increase from existing flows, causing some minimal riparian erosion as well as associated sedimentation.

Groundwater

Groundwater drawdown of more than 20 feet is anticipated to extend 4 to 5 miles from the edge of production within the coal seam. However, this value may vary, depending on the intensity of CBNG development and site-specific conditions. Minor impacts on shallow groundwater quality could occur, due to some infiltration from impoundments and from other water management practices.

Beneficial Reuse

The required use of Water Management Plans would increase beneficial reuse of production waters (more than 20 percent of the production water from a given well).

Indian Trust Assets

Impacts on Indian trust assets would be mitigated, as with the preceding discussion of surface water, groundwater, and beneficial reuse management requirements. Potential effects from groundwater drawdown would be reduced by implementation of a 5-mile buffer zone. With regards to Tribal CBNG resources, mitigation and monitoring measures would protect the resources of the Tribes. Wildlife monitoring and protection measures would be employed to prevent the loss of important hunting, fishing, and plant gathering locations. Traditional cultural property sites would be identified sooner through the use of block surveys and Tribal consultations. Air Quality impacts would be mitigated through site specific permits and implementation of the control measures included within the Air Quality Screen under Alternative H.

Lands and Realty

Impacts would result from ground disturbance associated with roads, utility corridors, and CBNG drill pads. The land disturbed by CBNG activities could range from approximately 32,850 acres (long-term) to as many as 55,100 acres (short-term). These acreages are less than 1 percent of the planning area analyzed (approximately 19.4 million acres).

Recreation

Adverse impacts from roads, utility corridors, and well pads would be balanced by the increased road access. The overall impacts of Alternative H would be limited in intensity and would vary greatly from site to site.

Social and Economic Values

Exploratory and production wells could result in some new employment opportunities and some associated increases in population, but the overall percentage increase would be less than 1 percent. These impacts would be economically beneficial, but the social impacts could be either beneficial or adverse.

Soils

Disturbance to soils would be minor, based on the estimate that only 32,850 acres (long-term) would be disturbed by CBNG activities. Changes in soil chemistry would also be minimal, based on the control of production water discharges and water quality protection measures.

Vegetation

Alternative H would potentially disturb nearly 55,100 acres in the initial short-term period. Of this, approximately 48,850 acres would be native vegetation consisting of 21,450 acres of grassland, 13,200 acres of shrubland, 11,700 acres of forest land, and 2,500 acres of barren land. Noxious weed controls would be employed to control the potential spread of these unwanted species. This disturbance is less than 1 percent of the acreage in the emphasis area.

No federal threatened or endangered plant species are known to occur within the Planning Area.

Visual Quality

Visual impacts would be moderate in nature and, in some cases, permanent. For example, power line access corridors are likely to be permanent and highly visible. Required management actions (mitigations) would lessen the impacts on visual quality by employing camouflage techniques and limiting development on certain visual resource classified areas.

Wildlife

Direct impacts on wildlife would include habitat loss, death from collisions with vehicles, and disturbance from human access. Mitigation of these impacts would occur through implementation of the control measures included within the Wildlife Screen under Alternative H.

Chapter 5: Consultation and Coordination

The BLM and the State conducted extensive consultation and coordination and provided opportunities for public comment during SEIS preparation. Public comment periods are intended to provide interested and concerned individuals opportunities to express their concerns and issues related to decisions the BLM should make.

The National Environmental Policy Act (NEPA) scoping and consultation included federal agencies, state departments, and Native American tribes. Key steps and dates in the consultation and coordination were as follows:

- The BLM published a Notice of Intent in the *Federal Register*, informing the public and other agencies that the SEIS process is beginning (August 5, 2005 (Vol. 70, No. 150, Page 45417).
- The BLM held four scoping meetings and circulated written requests for information and questions (August and September 2005).
- The BLM met with FWS and with other federal agencies, including the agencies that are official cooperators in the SEIS process. The BLM and the State also met with the Crow Tribe of Indians, and the Northern Cheyenne Tribe throughout 2005 - 2007.

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Acronyms and Abbreviations

Δdv	change in deciview
ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council on Historic Preservation
ADT	average daily traffic
ADY	Alternative Development Year
AIRFA	American Indian Religious Freedom Act
AOU	American Ornithologist's Union
ANC	acid neutralizing capacity
APD	Application for Permit to Drill
APLIC	Avian Power Line Interaction Committee
AQRV	Air Quality Related Value
ARCO	Atlantic-Richfield Company
ARM	Administrative Rules of Montana
Argonne	Argonne National Laboratory
ARS	Agricultural Research Service
AUMs	animal unit-months
BACT	Best Available Control Technology
BCF	billion cubic feet
BER	Board of Environmental Review
bgs	below ground surface
BIA	Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
BMP	Best Management Practice
BTU	British thermal unit
CAA	Clean Air Act
CBNG	coal bed natural gas
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CCS	Center for Climate Strategies
CFR	Code of Federal Regulations
CFS	cubic feet per second
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
COA	Condition of Approval
CSU	Controlled Surface Use
CWA	Clean Water Act
dBA	decibels
DEIS	Draft Environmental Impact Statement
DOE	U.S. Department of Energy
DNRC	Department of Natural Resources and Conservation (Montana)
DSEIS	Draft Supplemental Environmental Impact Statement
dv	deciview
EA	Environmental Assessment
EC	electrical conductivity
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FLM	Federal land managers

FLPMA	Federal Land Policy and Management Act
FR	Federal Register
FSEIS Statement	Final Environmental Impact
FWS	Fish and Wildlife Service (USDI)
FY	fiscal year
GHG	greenhouse gas
GIS	Geographic Information System
gpm	gallons per minute
GPO	Government Printing Office
GTI	Gas Technology Institute
HAP	hazardous air pollutants
HCP	Habitat Conservation Plan
HUD	U.S. Department of Housing and Urban Development
H_2S	hydrogen sulfide
ICC	Interstate Commerce Commission
ITA	Indian Trust Asset
kW	kilowatt
LGST	local government severance taxes
LRPL	Least Restrictive Proposed Limit
MAAQS	Montana Ambient Air Quality Standards
MBMG	Montana Bureau of Mines & Geology
MBOGC	Montana Board of Oil & Gas Conservation
MBTA	Migratory Bird Treaty Act
MCA	Montana Code Annotated
MCF	thousand cubic feet
MCFO	Miles City Field Office
MDA	Montana Department of Agriculture
MDEQ	Montana Department of Environmental Quality
MDT	Montana Department of Transportation
MEPA	Montana Environmental Policy Act
MFWP	Montana Fish, Wildlife, and Parks
mg/l	milligrams per liter
MGWPCS	Montana Groundwater Pollution Control System
MMB	Minerals Management Bureau
MMM	Minimum Mean Monthly
MNHP	Montana Natural Heritage Program
MPDES	Montana Pollutant Discharge Elimination System
MOA	Memorandum of Agreement
MRPL	Most Restrictive Proposed Limit
MSO IM	Montana State Office Instruction Memorandum
MT-GAP	Montana Gap Analysis Project
MOU	Memorandum of Understanding
MYBP	Millions of Years Before Present
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NO_X	oxides of nitrogen
NOA	Notice of Availability
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service (USDI)
NRCS	Natural Resources Conservation Service (USDA)
NRHP	National Register of Historic Places
NRIS	Natural Resource Information System (Montana)
NSO	no surface occupancy
NTE	Not to exceed
NWP	Nationwide 404 Permit

NWR	National Wildlife Refuge
O_3	Ozone
OF	Open File (Report)
OSHA	Occupational Safety and Health Administration
PM_{10}	particulate matter less than 10 microns in diameter (inhalable particulate matter)
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter (fine particulate matter)
POD	Plan of Development
ppm	parts per million
PRB	Powder River Basin
PRISM	Parameter-elevation Regressions on Independent Slopes Model
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
psig	pounds per square inch gauge
RCRA	Resource Conservation and Recovery Act of 1976
RFFA	Reasonably Foreseeable Future Actions
RFD	Reasonably Foreseeable Development
RMP	Resource Management Plan
RMU	Regional Monitoring Unit
ROD	Record of Decision
ROW	right-of-way
SAR	Sodium Adsorption Ratio
SAQA	Supplemental Air Quality Analysis
SCMA	Surface Coal Mining Act of 1977
SDWA	Safe Drinking Water Act
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Office
SIP	State Implementation Plan (Montana)
SMA	Special Management Area
SOC	Species of Concern
SN	Sundary Notice
SO_2	sulfer dioxide
SR	State Road (when followed immediately by the State Road number)
SWQATR	Surface Water Quality Analysis Technical Report
T&E	Threatened and Endangered
TAC	Technical Advisory Committee
TCF	trillion cubic feet
TCP	traditional cultural property
TDS	total dissolved solids
TLMD	Trust Land Management Division
TMDL	total maximum daily load
TOC	total organic carbon
TRR	Tongue River Railroad
μeq/1	microequivalents per liter
$\mu g/m^3$	micrograms per cubic meter
μS/cm	micro-Siemens per centimeter
UIC	underground injection control
U.S.	United States
USBR	Bureau of Reclamation (USDI)
U.S.C.	United States Code
USACE	U.S. Army Corp of Engineers
USDA	U.S. Department of Agriculture
USDC	U.S. Department of Commerce
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service (USDA)
USGS	U.S. Geological Survey (USDI)
VOC	volatile organic compounds
VMT	vehicle miles traveled
VRM	visual resource management

WAAQS	Wyoming Ambient Air Quality Standards
WET	whole effluent toxicity
WMA	Wildlife Management Area
WMP	Water Management Plan
WMPP	Wildlife Monitoring and Protection Plan
WNV	West Nile Virus
WQS	water quality standards
WRTR	Water Resources Technical Report
WSA	Wilderness Study Area
WYDEQ	Wyoming Department of Environmental Quality

CHAPTER 1

PURPOSE AND NEED

MONTANA

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

Introduction

In 2003, the Bureau of Land Management (BLM) and the state of Montana jointly prepared the Montana Final Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans (Statewide Document). The Statewide Document consisted of an analysis of the environmental impacts associated with the exploration and development of oil and gas resources, including coal bed natural gas (CBNG) in the Powder River and Billings Resource Management Plan (RMP) areas. The BLM Record of Decision (ROD) for the Statewide Document, approved on April 30, 2003, amended the Powder River and Billings RMPs to change existing land use decisions regarding development of oil and gas resources, including CBNG exploration and development.

As a result of lawsuits filed against BLM's ROD, the U.S. District Court issued orders, dated February 25, 2005, and April 5, 2005, that required BLM to 1) prepare a supplemental environmental impact statement (SEIS) to evaluate a phased development alternative for CBNG production, 2) include the proposed Tongue River Railroad (TRR) in the cumulative impact analysis and 3) analyze the effectiveness of water well mitigation agreements.

This Final SEIS (FSEIS) provides additional information and analyses regarding the topics identified by the U.S. District Court. The additional information supplements information in the Statewide Document with new information that is relevant to the purpose and need of the SEIS. This FSEIS has been prepared according to the National Environmental Policy Act (NEPA) of 1969, as amended, and the Federal Land Policy and Management Act of 1976 (FLPMA), as amended. It considers the three topics identified above at a programmatic planning level. Permits for proposed individual drilling and development activities will require site-specific NEPA review.

Additionally, this FSEIS updates the Statewide Document with new information and reflects any changes in policies, regulations, or activities since that document was approved. Summaries of monitoring data and the results of studies completed since the Statewide Document was finalized have been incorporated to update the public. These additions can be found in Chapter 3 under the individual resource topics, as well as in appropriate appendices.

Cooperating agencies assisting in the preparation of this FSEIS include the Environmental Protection Agency (EPA), Department of Energy (DOE), Bureau of Indian Affairs (BIA), U.S. Army Corps of Engineers (USACE), Montana Department of Environmental Quality (MDEQ), Montana Board of Oil and Gas Conservation (MBOGC), Lower Brule Sioux Tribe, Crow Tribe and the following counties: Big Horn, Carbon, Golden Valley, Musselshell, Powder River, Rosebud, Treasure, and Yellowstone. The Northern Cheyenne Tribe has also commented on the development of this FSEIS.

Conformance with the BLM Land Use Plans

The Billings RMP was approved through a ROD issued by BLM September 28, 1984. The Powder River RMP was approved through a ROD issued by BLM on March 15, 1985. BLM's 1994 Oil and Gas Amendment of the Billings, Powder River, and South Dakota RMPs amended these RMPs. The decisions made in the RMPs allow for a certain level of conventional oil and gas development on federal leases, support limited CBNG exploration and development, but do not include analysis for full-scale CBNG development:

"The [1992] Reasonably Foreseeable Development [RFD] projections can accommodate the drilling of test wells and initial small-scale development of CBM (*sic*). The extension of the nonconventional fuels tax credit for

What has Changed in Chapter 1 Since the Draft SEIS (DSEIS)?

Chapter 1 has been edited for the FSEIS so that the shaded text is consistent with the unshaded text in tense and conventionality. The purpose and need language for the FSEIS remains the same in Chapter 1, and throughout the FSEIS, to reflect that the state of Montana is not a co-lead for the FSEIS. While the Planning Area for the 2003 Statewide Document was the entire state; the BLM Planning Area for this FSEIS comprises the Billings and Powder River RMP areas only. Planning criteria presented in Chapter 1 have been updated to reflect a completed FSEIS. Note, text from the Statewide Document remains in this report (unshaded text) to provide background and context for the updated text (shaded) FSEIS.

wells drilled before December 31, 1993, should generate some activity in the Planning Area. This amendment does not contain either a hydrologic analysis of the RFD area or an environmental study of the impacts of building major pipeline systems. In order for development to occur on federal oil and gas lands, an additional environmental document tied to this amendment would be required" (BLM 1992).

The Statewide Document and this FSEIS will amend the Billings and Powder River RMPs for the management of federal oil and gas resources, including CBNG development.

The Planning Area

The Planning Area for the FSEIS encompasses BLM-administered lands and minerals in the Powder River and Billings RMP areas (Map 1-1). The Planning Area excludes those lands administered by other agencies such as the Forest Service; and sovereign tribal governments, such as the Crow Tribe of Indians, and the Northern Cheyenne Tribe. Indian allotted lands are also excluded from the Planning Area. BLM will make oil and gas decisions based on the Statewide Document and this FSEIS for the oil and gas estate it administers within the Powder River and Billings RMP areas.

The Powder River RMP Area encompasses the southeastern corner of Montana, including Powder River and Treasure counties, and portions of Big Horn, Carter, Custer, and Rosebud counties. The Powder River RMP area comprises approximately 1,080,675 acres of federally managed surface and 4,103,700 acres of federal mineral estate.

The Billings RMP Area comprises the south-central portion of Montana consisting of Carbon, Golden Valley, Musselshell, Stillwater, Sweet Grass, Wheatland, and Yellowstone counties and the remaining portion of Big Horn County. The Billings RMP area comprises approximately 425,336 acres of federally managed surface and 906,084 acres of federal mineral estate.

Adjacent to the Planning Area, other major land holdings include the Crow, and the Northern Cheyenne, Indian reservations, the Custer National Forest, the Big Horn Canyon National Recreational Area, the Burlington Northern and Santa Fe Railroad, and the Fort Keogh Agricultural Experiment Station.

Purpose of and Need for Action

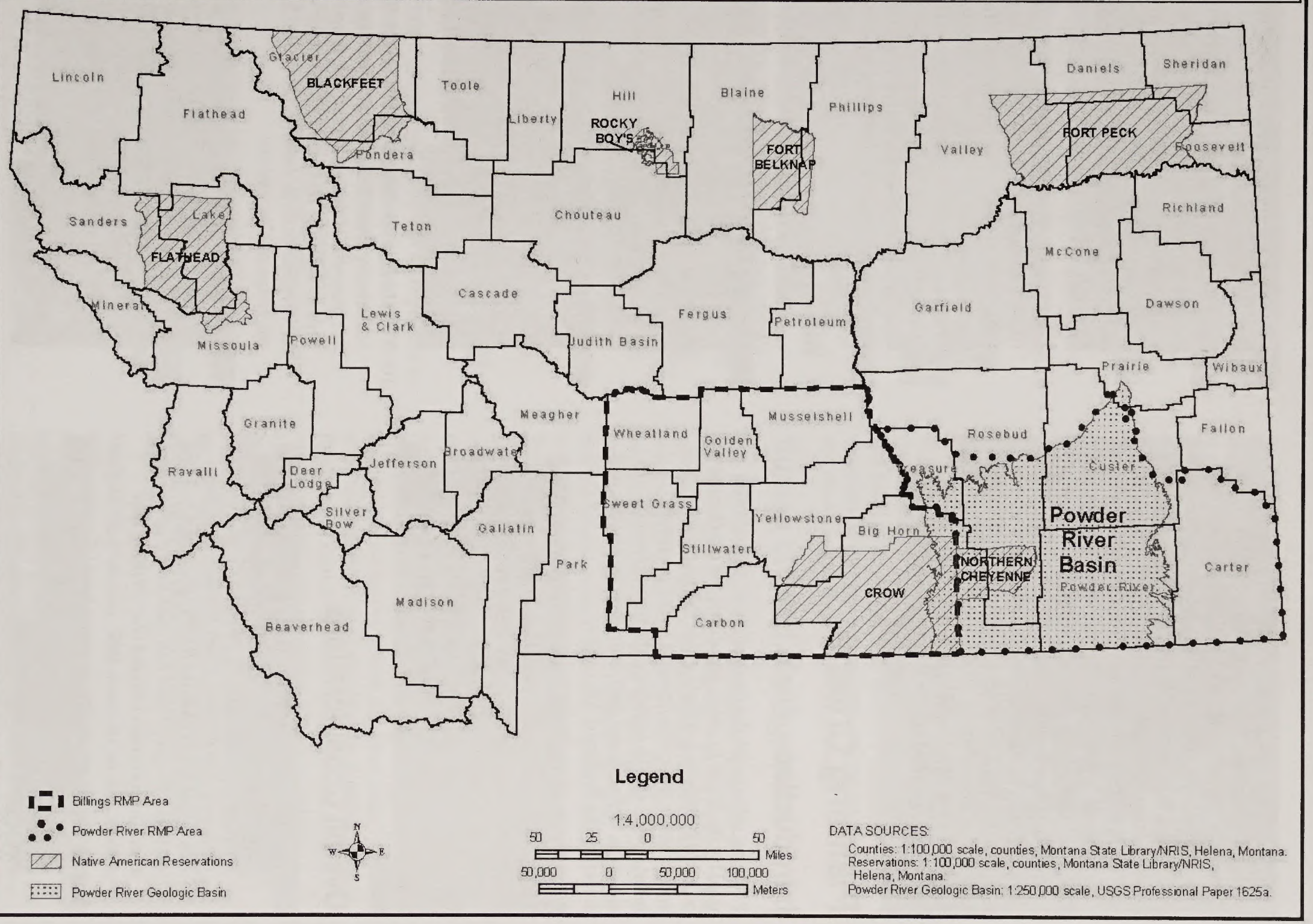
BLM and the state of Montana were co-leads for preparation of the Statewide Document. BLM is responsible for managing federally owned oil and gas resources. For BLM, the purpose of the Statewide Document was to analyze impacts from oil and gas activity, including CBNG exploration, production, development, and reclamation in the Powder River and Billings RMP areas. The FSEIS was used to analyze options for BLM to change its planning decision by considering oil and gas management options, including mitigating measures that will help address the environmental and social impacts related to CBNG activities.

The analysis in the Statewide Document focused on oil and gas development issues not covered in the Billings and Powder River RMPs, as amended by the 1994 Miles City Oil & Gas EIS/Amendment, such as water management from CBNG production and full field CBNG development. The alternatives provided a range of management options for amending the RMPs. The preferred alternative (Alternative E) was BLM's proposed and selected RMP amendment.

For the state of Montana, the purpose of the Statewide Document was to support the state's development of a program to address CBNG exploration, development, production, and reclamation in Montana. The FSEIS, in part, responded to the stipulation and settlement agreement, dated June 19, 2000, resulting from a lawsuit brought by the Northern Plains Resource Council challenging MBOGC in the Montana First Judicial District Court, Lewis and Clark County.

BLM published the original Notice of Intent for the Statewide Document in the Federal Register on December 19, 2000. BLM published the Notice of Availability in the Federal Register on January 17, 2003. Immediately following approval of the ROD on April 30, 2003, several lawsuits were filed against BLM's decision in the U.S. District Court. The U.S. District Court issued orders, dated February 25, 2005, and April 5, 2005, that required BLM to prepare an SEIS to evaluate a phased development alternative for CBNG production. The U.S. District Court also advised BLM to include the proposed TRR in the cumulative impact analysis and to analyze the effectiveness of water well mitigation agreements. This FSEIS addresses the three topics identified by the U.S. District Court. For the evaluation of CBNG phased development, this document analyzes

Map 1-1: Planning Area - Billings and Powder River RMP Areas



social impacts of phased development alternatives based on issues identified by the U.S. District Court, cooperating agencies, and public scoping comments. These phased development alternatives, coupled with the alternatives presented in the Statewide Document, provide a range of management options for amending the Powder River and Billings RMPs to address CBNG development. This SEIS updates the description of the Affected Environment (Chapter 3) and the Environmental Consequences (Chapter 4) presented in the Statewide Document with relevant new information. The FSEIS impact analysis in Chapter 4 also includes the cumulative impacts from the proposed TRR and addresses the effectiveness of water well mitigation agreements, as required under 85-11-175, Montana Code Annotated (MCA).

Planning Criteria

Introduction

Planning criteria are the constraints or ground rules used by the BLM to guide and direct the development of a RMP. Planning criteria guide the resource specialists in the collection and use of inventory information, and in analyzing the management situation, defining and analyzing the alternatives, and selecting the Preferred Alternative.

Planning criteria have been developed for the FSEIS. They ensure that the plan is tailored to the identified issues, and unnecessary data collection and analyses are avoided. Planning criteria are based on applicable laws and regulations; agency guidance; and results of consultation and coordination with the public, other federal, state, and local agencies, and Native American tribes.

Overall Considerations

1. The FSEIS supplements the Statewide Document. As a supplement to the Statewide Document, the FSEIS references the *Oil and Gas Final EIS and Proposed Amendment of the Billings, Powder River and South Dakota RMPs, Wyodak Coal Bed Methane Project Final EIS*, and *Board of Oil and Gas Conservation Oil and Gas Drilling and Production in Montana EIS.*

2. The FSEIS is in compliance with the Federal Land Policy and Management Act (FLPMA), NEPA, and all other applicable laws.

3. The FSEIS incorporates the requirements of BLM Handbook H-1624-1, *Planning for Fluid Minerals*, when considering a phased development alternative.

4. The format for the FSEIS follows the format from the Statewide Document.

5. The FSEIS has been prepared by an interdisciplinary team with specialists for recreation, fisheries, economics, sociology, archaeology, air quality, wildlife, hydrology, botany, soils, realty, minerals, and range management.

6. The Planning Area for BLM is the BLM-administered oil and gas estate in Wheatland, Golden Valley, Musselshell, Sweet Grass, Stillwater, Yellowstone, Carbon, Big Horn, Treasure, Powder River, and portions of Carter, Custer, and Rosebud counties. The Planning Area excludes those lands administered by other agencies (for example, Forest Service or Indian reservations).

7. The analysis area is any land that may be affected, regardless of ownership.

8. Data acquisition consists of projecting and compiling existing data, supplemented with data collected and acquired via research conducted since the Statewide Document was issued, data not available for the Statewide Document analyses, and appropriate literature search.

9. The SEIS considers and analyzes the effects from CBNG phased development; the cumulative effects from CBNG production, including from the proposed TRR; and a discussion on how private water well mitigation agreements will help alleviate the impacts from groundwater drawdown and methane migration.

10. The alternatives chosen will be economically and technically feasible. Those alternatives, or components of those alternatives, found not to be economically or technically feasible or viable will be dropped from or modified for consideration in the range of alternatives.

11. Scoping for the FSEIS helped define phased development, and the alternative(s) chosen are reasonable, achievable, and measurable. The theme for the alternative(s) considered follows those in the Statewide Document. Those alternatives, or components of those alternatives, found not to be reasonable, achievable, and/or measurable have been considered and dropped from further analysis.

12. Assumptions for the analyses, including the reasonably foreseeable development scenario and the reasonably foreseeable future actions from the Statewide Document are carried forward in the

FSEIS. Cumulative projects evaluated are carried forward with one known exception: the discussion was modified to include the cumulative effects from the proposed TRR.

13. The management and mitigation measures instituted since the Statewide Document ROD was signed are carried forward as features of the phased development alternatives in the FSEIS.

14. Native American consultation and coordination with the Crow and Northern Cheyenne Indian tribes located within the Planning Area as well as the Lower Brule Sioux Tribe have taken place in accordance with BLM Handbook 8120, *Guidelines for Conducting Tribal Consultations*. The intent of consultation and coordination is to ensure that tribal needs, and those of any other affected tribes, are considered and that BLM fulfills its trust responsibilities. Consultation is government-to-government between BLM and the tribes.

15. Interagency consultation occurs as necessary to comply with regulations, rules, and BLM policy.

16. New decisions in the ROD that are based on the FSEIS are intended to be compatible with existing plans and policies of adjacent local, state, tribal, and federal agencies, as long as the adjacent jurisdictional decisions conform with the legal mandates for management of public lands.

17. Any new decision or new mitigation measures required by the FSEIS must be enforceable, reasonable, achievable, and measurable and have to lend themselves to monitoring.

18. Current management guidance will be expanded to reflect recent resource regulations and guidelines pertaining to oil and gas operations.

19. To the extent practicable, this document will be consistent with adjoining Forest Service lands and leases.

20. Decisions will comply with Rangeland Health Standards.

21. A biological assessment will be prepared based on the preferred alternative and submitted to the U.S. Fish and Wildlife Service for its review and subsequent letter of concurrence.

Roles and Agency Responsibilities

Several federal agencies, sovereign tribal governments, and state agencies, as well as local county governments, were involved in the development and preparation of this FSEIS. Cooperating agencies include the BIA, DOE, EPA, USACE, MDEQ, MBOGC, and the following counties: Big Horn, Carbon, Golden Valley, Musselshell, Powder River, Rosebud, Treasure, and Yellowstone. The Crow Tribe of Indians and the Lower Brule Sioux Tribe signed Memoranda of Understanding (MOUs) with BLM to participate as cooperating agencies. The Northern Cheyenne Tribe also helped to prepare the FSEIS. BLM has the responsibility and the authority for preparation of the FSEIS.

The cooperating agencies and collaborators' roles were to participate in the review process of all technical reports and the preliminary draft SEIS. These agencies and tribal governments also attended numerous meetings both public and project-specific to discuss and enumerate concerns and comments.

Bureau of Land Management

The BLM's authority and decisions, related to oil and gas development in the Planning Area are limited to the agency's stewardship, resource conservation, and resource protection responsibilities for federal lands and minerals. As conservator of the federal surface and mineral estate, the BLM has responsibility for ensuring that the federal mineral resource is conserved (not wasted) and is developed in a safe and environmentally sound manner.

Drilling oil and gas exploration and production wells on lands where mineral rights are administered by the federal government must be conducted under an approved Application for Permit to Drill (APD) issued by the BLM. In considering whether to approve applications for permit to drill and other lease activities, the BLM must consider the possible impacts from typical exploration and development activities, and cumulative environmental effects, to ensure compliance with NEPA. This FSEIS, in combination with the Statewide Document, was prepared to meet those requirements. As part of the permit process, BLM requires that adequate bond coverage is in place prior to approval of drilling activity on federal minerals.

Much of the Planning Area contains lands known as "split estate." These are lands where the surface ownership is different from the mineral ownership. Management of federal oil and gas on these lands is somewhat different from management on lands where both surface and mineral ownership is federal. On split estate lands where surface ownership is private, and BLM administers the minerals, BLM places necessary restrictions and requirements on permitted activities

and works in cooperation with the surface owner. BLM has established policies for the management of federal oil and gas resources under the following statutes: FLPMA, NEPA, National Historic Preservation Act (NHPA), and Endangered Species Act (ESA) (see BLM 1992, under "Split Estate" for more information).

Regulatory areas where the BLM has shared responsibilities or consultation requirements with other federal or state agencies include the following:

- Oil and gas drilling—FLPMA of 1976, 43 U.S.C. 1701 *et seq.* as amended (Public Law [PL] 94-579), and the Mineral Leasing Act of 1920, as amended, (PL 93-153). This is a shared responsibility with the MBOGC.
- Activities that would impact waters of the U.S. from the discharge of produced waters—BLM must comply with the Clean Water Act (CWA) as provided by Sections 313 and 401 of the CWA, Section 313, 33 U.S.C. 1323. The National Pollutant Discharge Elimination System (NPDES) permits and 401 certifications are issued by the State of Montana for actions involving the discharge of water from point sources on non-Indian lands. For actions involving the discharge of water from point sources, BLM works with MDEQ on private and public lands, and with EPA on Indian lands. The BLM will not allow for the discharge of produced waters until approval is given by the State or EPA.
- Activities disturbing more than 1 acre (stormwater permitting) - BLM must comply with Section 402 of the CWA, and with the Montana Water Quality Act (WQA) (Administrative Rules of Montana [ARM], Title 17, Chapter 30, Subchapter 11). For actions involving the disturbance of more than 1 acre, BLM works with MDEQ on private and public lands, and with EPA on Indian lands. The BLM will not allow for the discharge of produced waters until approval is given by the State or EPA.
- Activities that would impact waters of the U.S. from the placement of fill materials—The U.S. Army Corps of Engineers and BLM have shared responsibility in Montana for dredge and fill permits associated with CBNG activities under Section 404, General Permit No. 404. This covers activities that impact waters of the U.S. as a result of placing fill in either waters of the U.S. or jurisdictional wetlands. See 33 CFR Part 320 and 40 CFR Part 230–Section 404(b)(1) Guidelines for the Specification or Disposal Sites for Dredged and Fill Materials.
- Special status species of plants or animals—ESA, U.S.C. 1531 et seq. This is a shared responsibility with the U.S. Fish and Wildlife Service (FWS) and Montana Fish, Wildlife, and Parks (MFWP).
- Cultural or historical resources—NHPA, 16 U.S.C. 470. BLM is required to consult with the Montana State Historic Preservation Office (SHPO) and Advisory Council on Historic Preservation (ACHP) in accordance with regulations found at 36 Code of Federal Regulations (CFR) 800 or through alternative procedures as specified through Programmatic Agreements. The BLM in Montana operates under a National Programmatic Agreement and a state-wide Protocol to meet its requirements under the NHPA.
- Air Quality Impacts - FLPMA (43 U.S.C. 1701 *et seq.*) and the Clean Air Act (CAA; 42 U.S.C 7401 *et seq.*) as amended, require that BLM assure the actions it conducts or authorizes (including oil and gas development) comply with all applicable local, state, tribal, and federal air quality laws, regulations, standards, increments, and implementation plans. Local, state, and tribal requirements may be more (but not less) stringent than federal requirements. The implementation of federal requirements is delegated to local, state, or tribal regulatory authorities, under EPA oversight.
- Surface water diversions, stream channel modifications, construction of new reservoirs, reservoir supply, or dam modifications to existing reservoirs, Montana Dam Safety Act, 85-15-207 (dams greater than 50 acre-feet). This is a shared responsibility with the MDEQ Water Resources.
- Oil and gas well spacing—Memorandum of Understanding (MOU) between BLM and the MBOGC concerning Oil and Gas Well Spacing/Well Location Jurisdiction, and the Montana Oil and Gas Conservation Act, Statute 82-11-201, Establishment of Well Spacing Units. This is a shared responsibility with the MBOGC.
- Consultation with Tribal Governments—Under Executive Order 13175, BLM will provide a meaningful opportunity for input by tribal officials where the action would have tribal implications. The Executive Order reflects the federal government's trust responsibility to federally recognized Indian tribes. Pursuant to this trust responsibility, the federal government establishes regular and meaningful consultation and collaboration with tribes on a government-to-government basis when federal activities may affect Indian tribes.

Protecting the U.S. Government and Indian lessors from loss of royalty as a result of oil and gas drainage is a prime responsibility of BLM. Under the terms of both federal and Indian leases, the lessee has the

obligation to protect the leased land from drainage by drilling and producing any well(s) that is necessary to protect the lease from drainage or in lieu thereof and with the consent of the authorized officer, by paying compensatory royalty. Drainage analysis, on the basis of a production screen or other criteria, is required by BLM's Drainage Protection Guidelines. Federal leases determined to be in danger of drainage are subject to geologic, engineering, and economic analyses in order to define the presence and magnitude of drained reserves.

The geologic analysis is a comprehensive examination of the lithologic, structural, and stratigraphic components of the subject reservoir to determine whether drainage is geologically possible. The subject reservoir is mapped to define its limits and physical characteristics using all available data. Differences between the BLM's independent geologic analysis and the lessee's geologic analysis, if submitted, are discussed and reconciled in the final report. The report describes in detail how the geology affects drainage in the subject area.

The reservoir engineering/economic analysis is the final examination of the reservoir performance, production history, and economic determinants to determine whether drainage is occurring or has occurred and whether an economic protection well could have been drilled. The BLM would evaluate any data submitted by the lessee and resolve or explain any significant differences. The BLM analyses will determine the measures necessary to mitigate the effects of drainage of hydrocarbons ranging from a mineral owner's demand to drill a protection well to holding the lessee liable for the value of drained resource.

Exploration and production wastes include produced water, oilfield production fluids (including drilling muds and fracture fluid flowback), crude oil and condensate, and contaminated soils. Produced water is managed under Onshore Order 7 (Disposal of Produced Water). Drilling muds, and fracture fluids are generally authorized for disposal by underground injection in Class II Underground Injection Control (UIC) wells under regulations of the MBOGC, or the EPA on tribal lands. Small, uneconomical quantities of crude oil and/or condensate, when wasted, are typically collected and sold to a waste oil recycler. Soils contaminated with exploration and production wastes can be disposed in a Subtitle D (nonhazardous) landfill, or may be treated onsite with the approval of the appropriate regulatory authority and surface lessee. Drilling mud is exempt from both the Hazardous Waste Program (ARM 16.44.304(2)(c), and the Montana Hazardous Waste Act. Drilling mud that contains less than 15,000 total dissolved solids (TDS) can be disposed of onsite with the landowner's permission.

State of Montana

State agencies that have authority over oil and gas activities include the Montana Department of Natural Resources and Conservation (DNRC) and MDEQ. The DNRC has two divisions involved in oil and gas development. These divisions are the Oil and Gas Conservation Division—also known as the MBOGC, and the Trust Land Management Division (TLMD). The MBOGC is the lead agency for regulating oil and gas development in Montana. The Board's responsibilities include issuing drilling permits, classifying wells, establishing well spacing units and land pooling orders, inspecting drilling, production, and seismic operations, investigating complaints, conducting engineering studies, establishing bonding requirements, and collecting and maintaining well data and production information. It also administers the federal Underground Injection Control Program for Class II injection or disposal wells in Montana to protect underground sources of drinking water.

Additional regulatory areas where the State of Montana has responsibility are managed by state agencies that have jurisdiction over some aspects of the oil and gas drilling and production. These agencies are the DNRC and MDEQ. The MFWP and the SHPO serve in advisory roles though they have no regulatory authority. Each of these agency's roles and responsibilities are discussed below.

Department of Natural Resources and Conservation

As a result of the 1995 legislative Natural Resource Agency reorganization, the "new" DNRC was formed. It combined the majority of programs from the old Departments of State Lands and Natural Resources and Conservation. Programs of the reorganized DNRC include: the MBOGC, TLMD, Reserved Water Rights Compact Commission, Forestry Division, Conservation and Resource Development Division, and Water Resources Division.

The DNRC is responsible for sustaining and improving the benefits derived from water, soil, and rangeland, managing the State of Montana's trust land resources, protecting Montana's natural resources through regulation and partnerships with federal, state, and local agencies, promoting conservation of oil and gas and preventing their waste through the regulation of exploration and production, and managing and assisting in the management of several grant and loan

programs. Sections addressing the responsibilities of the MBOGC, TLMD, and Water Resources Division as they pertain to oil and gas development follow this discussion.

Montana Board of Oil and Gas Conservation

The MBOGC is the lead state agency for regulating oil and gas development in Montana. It is a quasi-judicial body that is attached to the DNRC for administrative purposes. The law is quite specific regarding some of the MBOGC's makeup:

> *The board consists of seven members, three of whom shall be from the oil and gas industry and have had at least 3 years experience in the production of oil and gas, and two of whom shall be landowners residing in oil- or gas-producing counties of the state but not actively associated with the oil and gas industry, but one of the two landowners shall be one who owns the mineral rights with the surface and the other shall be one who does not own the mineral rights (MCA Section 2-15-3303).*

Additionally, one must be an attorney. All members are appointed to 4-year terms by the governor—four members (the majority) when he or she takes office, the others, 2 years later.

MBOGC's regulatory action serves three primary purposes: (1) to prevent waste of oil and gas resources, (2) to conserve oil and gas by encouraging maximum efficient recovery of the resource, and (3) to protect the correlative rights of the mineral owners, that is, the right of each owner to recover its fair share of the oil and gas underlying its lands. MBOGC also seeks to prevent oil and gas operations from harming nearby land or underground resources. Since 1993, MBOGC has performed the certification required for companies to receive tax incentives available for horizontal wells and enhanced recovery projects.

The MBOGC was established in 1953 with the passage of the Montana Oil and Gas Conservation Act (82-11-101, *et seq.*, Montana Code Annotated [MCA]). Under Montana law, no oil or gas exploration, development, production, or disposal well may be drilled until a bond has been posted and MBOGC issues a drilling permit. This requirement applies to all private, state, and most federal lands, but excludes proposals on allotted or tribal minerals. In November 1987, MBOGC and the BLM signed a cooperative agreement to coordinate their decisions regarding permits to drill. Under this agreement, MBOGC accepts for the record all permits to drill for federal oil and gas minerals in Montana.

The powers and duties of MBOGC in regulating oil and gas activities are defined in 82-11-111, MCA. MBOGC is charged with determining whether a waste of resources is existing or imminent. Based on their determination, MBOGC can take measures to prevent contamination of or damage to surrounding land and underground strata caused by drilling operations and production. These measures include, but are not limited to, regulating the disposal of produced salt water and the disposal of oil field wastes. The MBOGC regulations are located in Title 36, Chapter 22, of the *Administrative Rules of Montana* (ARM).

In 1989, the MBOGC prepared a programmatic EIS to assist in determining how to incorporate any necessary environmental review into its rules and permitting process in an effort to come into compliance with Montana Environmental Policy Act (MEPA). The programmatic EIS presented various alternatives for addressing environmental reviews during the permitting process. From these alternatives, MBOGC has adopted an environmental review process for permitting wells.

In conducting environmental reviews for new permits, MBOGC works with other state agencies that may become involved in the process. MBOGC was a co-lead agency on the 2003 statewide document, and signed its own ROD. The statewide document was prepared to assist in the review process and to meet the requirements of both MEPA and NEPA for CBNG development. The 2003 statewide document continues to serve this function for MBOGC.

Trust Land Management Division

The TLMD is responsible for managing the surface and mineral resources of forest, grazing, agricultural, and other classified state trust lands to produce revenue for the benefit of Montana's public schools and other endowed institutions. The TLMD manages more than 5.1 million acres of surface acreage and in excess of 6.3 million acres of mineral acreage.

The TLMD is divided into four bureaus: the Minerals Management Bureau, Agriculture and Grazing Management Bureau, Forest Management Bureau, and Special Uses Management Bureau.

The TLMD administers mineral leases on its school trust land mineral estate and, as a courtesy, other state agency's mineral estate. Leasing procedures will not change because of management alternatives. It should be noted that the TLMD is responsible for management of surface and mineral acreage, while some other

agencies perform in more of a regulatory role. The TLMD must comply with MEPA. MEPA is required for state-proposed actions. The process is implemented both at the leasing stage and for proposed plans of operation (drilling plans). For plans of operation, it is conducted by the area offices. Information, management restrictions, and environmental documents are then forwarded to the Minerals Management Bureau for approval. The Minerals Management Bureau then notifies operators of their decision to approve or disapprove.

Water Resources Division

The Water Resources Division is responsible for various programs coupled with the development, uses, and protection of Montana's water. It oversees the state-owned water resource projects, water rights, and water reservoirs. Its activities include centralized water rights record keeping, state water planning, floodplain management, dam safety, drought planning, and interstate coordination of water issues. The division provides administrative support to the Board of Water Well Contractors, a board that licenses well drillers and establishes minimum well construction standards.

Through the state water planning process, the division also guides the development of the state water plan and statewide water policies and laws. The state water plan is a progressive, collaborative, and citizen-based process for improving the management of the state's water resources. Other responsibilities include staffing the Drought Advisory Committee and coordinating drought responses, assisting in the planning and developing of water storage projects, analyzing the effects of proposed new water uses on existing water rights, protecting Montana's water from interstate, regional, and international threats, responding to federal laws and actions that potentially affect Montana's water, and providing water resource education to Montanans through the Montana Watercourse.

The division helped draft the *Powder River Basin Controlled Groundwater Area Final Order* that was signed by the DNRC director on December 15, 1999. A copy of the order is contained in Appendix A of the Water Resources Technical Report (ALL 2001b) prepared for this EIS. The order is intended to protect existing water users from impacts of CBNG development. The order recommends monitoring and reporting standards, establishes a Technical Advisory Committee, and calls for the implementation of mitigation agreements between surface owners and CBNG operators. The Technical Advisory Committee makes recommendations to the MBOGC regarding specific site monitoring and reporting requirements. The MBOGC has enforcement authority over monitoring and reporting requirements for continuing CBNG operations as established in the Boards' Order 99-99, *Establishing CBM Operating Standards*. These requirements have been codified into the MCA as 85-11-175, MCA.

Montana Department of Environmental Quality

MDEQ has two divisions directly or indirectly involved with oil and gas development: Permitting and Compliance, and Planning, Prevention, and Assistance. The following are brief descriptions of the role of each division:

- The Permitting and Compliance Division is in charge of permit issuance and compliance monitoring for projects relating to air, water, public water supplies, solid and hazardous waste, subdivisions, motor vehicle recycling, open cut, hard rock, coal and uranium mines, and applicable facilities under the Major Facility Siting Act. Nearly all permits and authorizations issued by MDEQ are handled through this division.
- The Planning, Prevention, and Assistance Division is involved with planning, policy, and standards development relating to air quality State Implementation Plans, water quality, non-point source management, groundwater protection, and solid waste management.

MDEQ administers MEPA, Montana's Hazardous Waste Management Act, Clean Air Act, the Solid Waste Management Act, Water Quality Act, Major Facility Siting Act, and the Montana Pollutant Discharge Elimination System (MPDES) permitting process. The Water Protection Bureau (WPB) issues wastewater discharge permits under the MPDES permit program pursuant to the 75-5-402, MCA of the Montana Water Quality Act (WQA) and Sections 402 and 303 of the federal Clean Water Act (CWA). MDEQ is responsible for investigating the environmental impacts associated with continued oil and gas activities in accordance with MEPA and the EIS process. MDEQ was a co-lead agency on the 2003 statewide document, and signed its own ROD.

MDEQ has delegated responsibility under the Federal Clean Water Act (P.L. 92-500) and Montana Water Quality Act (75-5-101, *et seq.*) to monitor and assess the quality of Montana surface waters for toxic and conventional pollutants, to prepare plans to control pollution, to assess water quality conditions and trends, to report them to the EPA and Congress, and to identify impaired or threatened stream segments and lakes. Furthermore, the state must provide a program for the prevention, abatement, and control of water pollution. The CWA and EPA's implementing regulations require

that discharges with the potential to cause or contribute to water quality standards excursions be subject to water quality based effluent limitations as stringent as necessary to meet water quality standards. Recent amendments to the Montana Water Quality Act (MCA 75-5-702, effective May 1997) require the Department to consider all currently available data when making water quality assessments, including information or data obtained from federal, state, and local agencies, private entities, or individuals with an interest in water quality protection.

The MDEQ is also responsible for issuing federal CWA Section 401 certification for activities that are licensed or permitted by a federal agency and may result in a discharge to state waters. The Department has adopted administrative rules for the issuance of CWA Section 401 certifications at Title 17, Chapter 30, Subchapter 1 ARM, pursuant to ARM 17.30.105(2)(b).

The MDEQ also administers the MPDES Storm Water Discharge Permitting Program. Owners/operators of Coal Bed Methane exploration, production, processing, or treatment operations, or of associated transmission facilities, are exempt from needing coverage under the MDEQ's MPDES "*General Permit for Storm Water Discharges Associated with Mining and with Oil & Gas Activities.*" The permit is contingent on the discharge being composed entirely of storm water that has not come into contact with, or been contaminated by contact with, any overburden, raw material, intermediate products, finished products, byproducts, or waste products located on the site. If there has been a reportable quantity release, coverage is required under the general permit.

Construction activities associated with CBNG operations are subject to potentially requiring coverage under the MDEQ's MPDES "*General Permit for Storm Water Discharges Associated with Construction Activity.*" A storm water permit may be required when the area of total construction-related disturbance exceeds 1 acre. Permit coverage is obtained by submitting a Notice of Intent (NOI) package, including a completed NOI form, Storm Water Pollution Prevention Plan, and fee before the proposed construction start date. The determination of whether MPDES General Permit coverage for construction is required, or if more than one NOI is necessary under the General Permit, is based on the discharge(s) of storm water runoff to surface water, the acreage of disturbance(s) resulting from construction activity, proximity of construction-related disturbance to surface water, overall time period of construction, contractor(s) performing the construction activity, and number of drainage basins or receiving waterbodies. When areas with construction-related disturbance have been stabilized, permit coverage under the General Permit may be terminated.

MDEQ–Air & Waste Management Bureau (AWM) also has delegated responsibilities under the federal Clean Air Act (42 U.S.C. 7401, *et seq.*) that requires the State to operate an approved ambient air quality monitoring network for the purpose of evaluating compliance with the National Ambient Air Quality Standards (NAAQS), to report air quality monitoring information to the EPA, and to prepare plans for controlling air pollution. Additionally, the state is required under the Clean Air Act of Montana (75-2-101, *et seq.*) to provide a coordinated statewide program of air pollution prevention, abatement, and control. When actual locations and operational requirements for gas compression facilities (CBNG development) are determined, permit applications would be submitted to MDEQ-AWM. At that time, additional site-specific, air quality analyses, such as the Best Available Control Technology (BACT) analysis or Prevention of Significant Deterioration (PSD) increment analysis, may be performed.

Potential decisions to be made by the Air Resources Management Bureau of the MDEQ include making determinations as to whether a Montana Air Quality Permit would be required for the proposed activities. However, the ARM, Title 17, Chapter 8, Subchapter 7 – Permit, Construction and Operation of Air Contaminant Sources, specifically exempts certain activities from the requirement to obtain a Montana Air Quality Permit (MAQP). ARM 17.8.744(1)(b) exempts mobile emitting units, including motor vehicles, aircraft, and other such self-propelled vehicles from obtaining a MAQP. In addition, ARM 17.8.744(1)(i) exempts drilling rig stationary engines and turbines that do not have the potential to emit more than 100 tons per year of any regulated pollutant and that do not operate in any single location for more than 12 months from obtaining a MAQP.

Any future development, such as the placement of compressor engines or turbines, would also require a permit determination from MDEQ. ARM 17.8.743 requires that a person may not construct, install, modify, or operate a new facility or emitting unit upon which construction was commenced, or that was installed after November 23, 1968, that is not specifically excluded under ARM 17.8.744, and that has the potential to emit more than 25 tons per year of any regulated airborne pollutant, other than lead, without first obtaining a MAQP.

Montana Fish, Wildlife, and Parks

MFWP is responsible for the conservation and associated management of the fish, wildlife, parks, and recreational resources of Montana. This department advises other agencies of wildlife concerns.

MFWP will be involved, as needed and as agreed upon, in the inventory and monitoring of fish and wildlife species, review of plans of development (PODs), participation on the core team associated with implementation of the Wildlife Monitoring and Protection Plan (WMPP), and in providing general oversight on issues related to fish and wildlife or their habitats.

State Historic Preservation Office

Under the National Historic Preservation Act of 1966 as amended, states were given certain responsibilities. These responsibilities have been assigned to the SHPO, which is a program within the Montana Historical Society. The SHPO provides assistance in the following areas: the identification and listing of properties on the National Register of Historic Places (NRHP), historic building maintenance and rehabilitation, archaeological sites and research, tax incentives for preservation, community surveys, the PLACES program (Peoples, Lands, and Cultural Environments), National Register Signs, local government and grant assistance, preservation education, and state and federal agency responsibilities. The SHPO provides information regarding the procedures that state and federal agencies must follow to consider historic and archaeological resources in their activities and programs.

BLM in Montana coordinates its preservation activities with the Montana SHPO through a formal protocol implementing BLM's National Programmatic Agreement for Cultural Resources (BLM 1997b).

Tribal Governments

The following two sections address the roles and responsibilities of the Crow Tribe of Indians and the Northern Cheyenne Tribe as they relate to the development of CBNG on and around their reservations.

Crow Tribe of Indians

The Crow Tribe's territorial jurisdiction as administered by the General Council extends to all lands within the exterior boundaries of the Crow Indian Reservation. The Crow Tribal Court has civil jurisdiction over all persons who reside, enter, or transact business within the reservation including non-Indian activities on private lands within the reservation that may directly impact reservation lands or tribal welfare. The Crow Tribe's Constitution (Crow Tribe, 2001) tasks the Executive Branch with management and development of natural resources pending final approval of the Legislative Branch for any mineral agreement.

Within the context of resource utilization, the Crow Tribe's Natural Resources and Environmental Departments may establish codes and set standards under federal statutes or inherent tribal authority for regulating activities that affect the tribal resources and environmental conditions. The Crow Tribe is in the process of developing and implementing several environmental and land use planning codes, including a tribal environmental policy act, water quality act, and cultural resource protection act.

The tribe has developed Draft Water Quality Standards and Draft Air Quality Standards, which will govern all development actions once these requirements are officially enacted. All mineral leasing and permitting for development, exploration, and right-of-way (ROW) authorization on Tribal or Allotted lands, is subject to federal approval and 25 CFR regulations enforced through BIA and BLM procedures.

The 1984 EPA *Indian Policy* acknowledges tribal governments as the primary parties for setting standards, making environmental policy decisions, and managing reservation programs consistent with agency standards and regulations. The EPA will assist interested tribal governments in developing programs and in assuming regulatory responsibility for reservation lands. Until the Crow Tribe is granted formal primacy for these delegated programs, the EPA will retain management and enforcement responsibilities.

The Crow Tribe continues to plan for development of its CBNG and coal resources within the reservation and the Planning Area.

The Northern Cheyenne Tribe

The Northern Cheyenne Tribal government is structured by a Constitution and By-laws endorsed by the tribe and approved by the Secretary of the Interior in 1936. The Northern Cheyenne amended their Constitution in 1960 and in 1996 to address changes in their governmental structure. The Northern Cheyenne Government is organized into three branches, an executive branch, a legislative branch, and a judicial branch.

The Executive Branch oversees a series of boards, commissions and programs, some of which deal with the regulation and control of natural resources. Through

these boards and programs, the Executive Branch administers federal contracts and grants, and conforms to federal standards for environmental quality.

The Legislative Branch (Tribal Council) has the power to negotiate with the federal, state, and local governments, approve or prevent the sale, disposition, or lease of tribal lands including oil and gas, eminent domain, and protect and preserve tribal natural resources. The Tribal Council also has economic powers such as the right to engage in any business that might further the economic interests of the tribe or to carry out other economic activities that are not inconsistent with their constitution.

The Judicial Branch has the power to review the constitutionality of ordinances adopted by the Tribal Council, including mineral leases.

The Northern Cheyenne Tribe has redesignated their lands under the CAA as a PSD Class I area. The allowable incremental impacts within PSD Class I areas are very limited. The CAA directs the EPA to promulgate the Tribal Authority Rule, establishing tribal jurisdiction over air emission sources on both trust and private lands within the exterior boundaries of tribal lands. The Northern Cheyenne are currently in the process of developing a tribal Implementation Plan, to submit a "Treatment as State" application to the EPA. Requesting that the Tribe be treated in the same manner as a state under the CAA will allow them to participate in Section 105 grants and have formal recognition as an affected "state" when permits are written for sources within 50 miles of tribal lands.

The Northern Cheyenne Tribe has a formal water code that the Secretary of the Interior approved on October 9, 2001. The Northern Cheyenne Water Resource Administrator manages tribal water resources on the reservation including, but not limited to, storage water in the Tongue River and Big Horn Reservoirs. The Natural Resources Board serves as the Water Board. The board provides oversight for implementation of the code and permitting process to account for beneficial use of the tribe's water. The water code is enforceable for all activities affecting tribal waters on the reservation.

On April 29, 2002, the Tribe submitted an application under Section 518 of the CWA for "Treatment as a State" (TAS). This was done to administer the CWA Section 303(c) water quality standards and CWA Section 401 water quality certification programs. On December 2, 2003, the tribe supplemented its application. EPA approved the Northern Cheyenne Tribe's application for TAS on August 11, 2006.

On June 4, 2002, the Tribal Council adopted tribal water quality standards which became effective on July 15, 2002. On April 21, 2005, the tribe held public hearings to take comments on the updated water quality standards. Tribal staff is currently preparing a final, updated standards package for consideration by the Tribal Council. After approval by the Tribal Council, the new standards will be submitted to EPA for review and approval pursuant to CWA Section 303(c).

A complete explanation of the Draft Standards can be found in the Northern Cheyenne portion of the Native American section of Chapter 3.

Other Federal Agencies

Environmental Protection Agency

Under Section 402 of the CWA, 33 U.S.C. Section 1342, and 40 CFR Parts 122-125, EPA has authorized the state of Montana to issue National Pollutant Discharge Elimination System (NPDES) permits for discharges of pollutants from point sources into waters of the U.S. located in Montana, excluding Indian country as defined at 18 U.S.C. 1151. EPA retains an oversight and partnership role in state NPDES programs. As described in 40 CFR Part 123, Subpart C, EPA reviews proposed state NPDES permits for compliance with CWA requirements. For discharges in **Indian country** (a term that is defined in 40 CFR Section 122), EPA has direct implementation authority for issuing NPDES permits. The following sections of the CWA also apply:

- **CWA Section 401, 33 U.S.C. Section 1341, and 40 CFR Part 121.** These provisions describe EPA's role in addressing certain discharges in one state that may affect the quality of water within any other state. This role is particularly important due to the difference in surface water quality standards developed by Montana and Wyoming.

- **CWA Section 518, 33 U.S.C. Section 1377, and 40 CFR Part 131.8.** In June of 1999, the Crow Tribe submitted a draft application to EPA to administer a water quality standards program. The Northern Cheyenne Tribe submitted a draft application to EPA to administer water quality standards in January of 2001.

- **CWA Section 303 (c).** This section requires states and authorized Indian tribes to submit new or revised water quality standards to EPA for review. EPA reviews and approves or disapproves the submitted standards. If EPA determines that any standard is not consistent with the requirements of the Act, EPA

notifies the state or authorized tribe and specifies the changes needed. If needed changes are not adopted, EPA is to promptly propose and promulgate a federal standard. NPDES permits must include limits as stringent as necessary to meet water quality standards (40 CFR 122.44). When waters are monitored and assessed, the data are compared to the water quality standards to determine whether the water is impaired and whether discharges have the reasonable potential to cause or contribute to such impairments.

- **CWA Section 303(d), 33 U.S.C. Section 1313(d) and 40 CFR Part 130.** These provisions require states to identify waters that need Total Maximum Daily Loads (TMDLs) standards and to establish TMDLs for them, with an oversight and partnership role for EPA. Currently, EPA and the State of Montana are subject to a court order that prohibits NPDES permits for new or increased discharges into any water body that has been listed as needing any TMDLs standards until all necessary TMDLs standards are established for a particular water quality limited segment (U.S. District Court 2000). TMDLs for the Tongue River, Powder River, and Rosebud Creek are in development (see http://www.deq.state.mt.us/wqinfo/TMDL/TonguePowderRosebudTMDL.asp).

The Safe Drinking Water Act (SDWA) also applies to CBNG projects, specifically, 42 U.S.C. Section 300f, *et seq.*, particularly 42 U.S.C. Sections 1421 *et seq.*, and 40 CFR Parts 144-147 regarding UIC. Should produced water from CBNG operations be injected into the ground, UIC permits may be necessary. EPA and the states administer UIC programs to protect underground sources of drinking water. EPA administers the programs for Class V UIC wells in the State of Montana and for all classes of UIC wells on Indian lands in Montana. EPA has approved Montana's program for administering the UIC program for Class II wells. EPA retains an oversight and partnership role with the state for these programs. EPA's approvals of the state's authority to administer these programs do not extend to Indian country.

EPA also administers Section 309 of the CAA, 42 U.S.C. Section 7609. This provision calls for EPA to review and comment on the environmental impact of major federal actions to which the NEPA, 42 U.S.C. Section 4332(2)(C), applies.

Bureau of Indian Affairs

BIA is responsible for the approval of any lease, agreement, permit, or document that could encumber lands and minerals owned by either tribes or allottees. Title to these resources is held by the U.S. Government in trust. As such, agreements or arrangements, involving the trust assets that tribes or allottees make are not binding until they have been approved by the trustee. The agency that has been authorized to act as the trustee to keep the resources from being harmed or alienated is the BIA.

Within the Crow Reservation, there are approximately 1,497,000 acres of trust land out of the 2,282,000 total acres within the boundary. The Northern Cheyenne Reservation is composed of 444,000 acres within the external boundary. Of that amount, 442,000 acres are held in trust. (Land Titles and Records Office, BIA, Rocky Mountain Regional Office 1994).

The BIA intends to adopt the SEIS for future decisions it may have to make on hydrocarbon exploration and production with an emphasis on CBNG involving trust minerals. Such decisions relate to approval of leases, agreements, easements and/or ROW associated with exploration and production. The BIA will rely on the reasonably foreseeable development estimates and cumulative impact analysis anticipated for the region. The science and analysis components of the document may be incorporated in future BIA NEPA compliance documents.

U.S. Department of Energy

Fossil Energy

The Office of Fossil Energy is charged with enhancing the U.S.' economic and energy security through the following actions:

- Managing and performing energy-related research that promotes the efficient and environmentally sound production and use of fossil fuels.
- Partnering with industry and others to advance clean and efficient fossil energy technologies toward commercialization.
- Managing the Strategic Petroleum Reserve to reduce vulnerability to economic, national security, and foreign policy consequences of supply interruptions.
- Supporting the development of information and policy options that benefit the public by ensuring access to adequate supplies of affordable and clean energy.

Office of Fossil Energy—Oil and Gas Program

The primary mission is to assure that fossil energy resources can meet increasing demand for affordable energy without compromising the quality of life for future generations. This program has been at the

forefront of research to advance fossil energy exploration, supply, and end-use technologies.

The Oil and Gas programs include the following:

- **Natural Gas Technologies.** Pursuing advances in exploration and production, infrastructure reliability, and technologies including fuel cells and gas turbines systems.
- **Oil Technology.** Enhancing the efficiency of oil exploration, recovery, and processing while improving environmental quality.
- **Gas Energy Systems Dynamics.** Activities will lead to the development of the next generation of gas turbines, fuel cells, coupled turbine-fuel cell systems, and reciprocating engines, and lay the foundation for new gas utilization technologies.
- **Ultra Clean Fuels.** Developing enabling science for the production of ultra-clean and affordable fuels from fossil resources for high-efficiency transportation systems.

U.S. Army Corps of Engineers

The legislative origins of USACE's permitting program are the Rivers and Harbors Act of 1890 (superseded) and 1899 (33 U.S.C. 401, et seq.). Various sections establish permit requirements to prevent unauthorized obstruction or alteration of any navigable water of the United States. The most frequently exercised authority is contained in Section 10 (33 U.S.C. 403), which covers construction, excavation, or deposition of materials in, over, or under such waters, or any work that would affect the course, location, condition, or capacity of those waters. The authority is granted to the Secretary of the Army. Other permit authorities in the Act are Section 9 for dams and dikes, Section 13 for refuse disposal and Section 14 for temporary occupation of work built by the United States. Various pieces of legislation have modified these authorities, but have not removed them.

In 1972, amendments to the Federal Water Pollution Control Act added what is commonly called Section 404 authority (33 U.S.C. 1344) to the program. The Secretary of the Army, acting through the Chief of Engineers, is authorized to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material into waters of the United States at specified disposal sites. Selection of such sites must be in accordance with 404(b)(1) Guidelines developed by EPA in conjunction with the Secretary of the Army. The discharge of all other pollutants into waters of the United States is regulated under Section 402 of the Act, which supersedes the Section 13 permitting authority mentioned above. The Federal Water Pollution Control Act was further amended in 1977; it was given the common name "Clean Water Act" and was again amended in 1987 to modify criminal and civil penalty provisions and to add an administrative penalty provision.

The purpose of the Section 404 program is to ensure that the physical, biological, and chemical quality of U.S. water is protected from irresponsible and unregulated discharges of dredged or fill material that could permanently alter or destroy the valuable resource.

Section 404 of the Clean Water Act requires that approval be obtained before discharging dredged or fill material into the waters of the United States. Typical activities requiring Section 404 permits are as follows:

- Depositing of fill or dredged material in waters of the U.S. or adjacent wetlands
- Site development fill for residential, commercial, or recreational developments
- Construction of revetments, groins, breakwaters, levees, dams, dikes, and weirs
- Placement of riprap and road fills

The Secretary of the Army has delegated most of these permit authorities (with the specific exception of Section 9) to the Chief of Engineers and that individual's authorized representatives. Any person, firm, or agency (including federal, state, and local government agencies) planning to work in, dump, or place dredged fill in waters of the United States must first obtain a permit from the Corps of Engineers. Permits, licenses, variances, or similar authorizations may also be required by other federal, state, and local statutes. Waters of the United States include essentially all surface waters such as all navigable waters and their tributaries, all interstate waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters.

Agency Permits and Reviews

Table 1-1 shows the agencies and applicable permits or reviews potentially required for oil and gas operations on federal minerals. Table 1-2 is a matrix showing the permittable activity and the responsible agency issuing a permit or approval.

TABLE 1-1

APPLICABLE PERMITS/REVIEWS FOR OIL AND GAS DEVELOPMENT ACTIVITIES

Agency	Review/Permit/Approval
Bureau of Land Management (BLM)	Approval of PODs, APDs and Sundry Notices (SNs) on federal leases. Approval or issuance of ROW on federal surface.
	Review all applicable Federal, State and local laws, rules, regulations and permits for Federal mineral development, found below.
	Approval of Communitization Agreements and Federal Unit Agreements.
	BLM determines need for inventory and, if necessary, mitigation to meets its obligations under the NHPA, Native American Graves Protection and Repatriation Act (NAGPRA), other Federal Preservation Laws, Regulations, Executive Orders, and Departmental and Bureau Policies. BLM's cultural resource requirements for CBNG projects are found in the Cultural Resources Appendix (Appendix E) of the BLM 2003 POD Guidance Manual.
	American Indian Religious Freedom Act (AIRFA) and Executive Order 13007 acknowledges the rights of Native Americans to practice traditional religion, have access to and protect religious sites, and possess sacred objects.
U.S. Army Corps of Engineers (USACE)	Section 404 of the Clean Water Act—regulates the discharge of dredged or fill material into waters of the U.S.; Section 404 permit.
U.S. Fish and Wildlife Service (FWS)	Review under ESA including the issuance of Biological Opinions or Letters of Concurrence. The Service also provides recommendations for protective measures for migratory birds in accordance with the Migratory Bird Treaty Act (MBTA), Bald and Golden Eagle Protection Act (BGEPA), Executive Orders 11990 and 11988, CWA, Fish and Wildlife Coordination Act (FWCA), and the Fish and Wildlife Act (FWA).
U.S. Environmental Protection Agency (EPA)	Regulates Underground Injection Control (UIC) Class V injection program/UIC Permit.
	Regulates all classes of underground injection wells and all point source discharge to streams for any source located in Indian country.
	ESA review for NPDES permits, TMDLs and Water Quality Standards (WQS) on state and tribal lands.
	Clean Air Act (CAA)—(42 U.S.C. 7401, *et seq.*) Air quality permitting for air pollutant emitting sources within the exterior boundaries of tribal lands.
	404 enforcement under the CWA for dredge and fill activities.
	401 Discharge certification under the CWA on tribal lands and certain discharges in one state that may affect the quality of water within any other state.
	518 under the CWA for approval or disapproval of Tribal Water Quality Standards.
	Section 303(d) of the CWA regarding EPA's oversight and partnership role with states to identify streams that do not meet the CWA objectives by establishing TMDLs for such streams.

TABLE 1-1

APPLICABLE PERMITS/REVIEWS FOR OIL AND GAS DEVELOPMENT ACTIVITIES

Agency	Review/Permit/Approval
Montana Department of Environmental Quality (MDEQ)	Administers MEPA (75-1-101, MCA). Clean Air Act of Montana (75-2-101 *et seq.*, MCA)(ARM 17.8). Air quality permitting for air pollutants emitting sources outside the exterior boundaries of tribal lands. Resource Conservation and Recovery Act (RCRA) Waste Disposal—Hazardous Waste Management Act (75-10-401, MCA ARM 17.53.101). Solid Waste Management Act (75-10-201, MCA) (ARM 17.50.501). Water Quality Act (75-5-401 through 405, MCA). Montana Surface WQS (ARM 17.30.601 *et seq.*). 401 Discharge Certification under the CWA. Montana Nondegradation Rules (ARM 17.30.701 *et seq.*). Montana Pollutant Discharge Elimination System (MPDES) (ARM 17.30.1201-1426). Certificate of environmental compatibility—Major Facility Siting Act (75-20-101, MCA). Montana Groundwater Pollution Control System (MGWPCS) (ARM 17.30.100 *et seq.*).
Montana State Historic Preservation Office (SHPO)	Review under the National Historic Preservation Act (NHPA) regarding identification and evaluation of cultural/historic resources.
County Weed Districts	Review for control and prevention of noxious weed infestations under the Noxious Weed Control Law (7-22-2101, MCA).
Local Conservation District	Montana Natural Streambed and Land Preservation Act (310 Permit).
Rosebud County	Rosebud Conservation District's Land Use Ordinance 1 for Coal Bed Methane Produced Water—This ordinance addresses the following major points: reclamation bond for CBNG impoundments, beneficial use permit required to produce water, required lining of CBNG impoundments, required monitoring of CBNG managed irrigation sites, and required surface owner consent for placement of impoundments and managed irrigation areas.
Montana Department of Natural Resources and Conservation (DNRC)	See descriptions for individual bureaus and divisions listed below.
Trust Land Management Division (TLMD)	Approval of activities on state trust surface and mineral estate (subsurface) lands; issuing land use licenses, easements, and mineral leases; conducting land exchanges; manages grazing permits.
Minerals Management Bureau (MMB)	Responsible for leasing, permitting, and managing mineral leasing program.
Water Resources Division, Water Rights Bureau	Permit to allow beneficial use of groundwater and surface water. (85-2-310 to 312, MCA). Permitting of reservoirs with storage capacities over 50 acre-feet.
Montana Board of Oil and Gas Commission (MBOGC)	Approval of state drilling permits on state and private leases (APDs). (ARM 36.22) (82-11-111, MCA). Oversee UIC program for Class II wells (ARM 36.22.1401)(82-11-101, MCA). RCRA-exempt Solid Waste Disposal (ARM 36.22.1105). Surface Restoration (ARM 36.22.1307).

TABLE 1-2

PERMITTABLE ACTIVITIES FOR CBNG DEVELOPMENT

Permittable Activity	Federal Agencies	State Agencies
Drilling on a Federal Lease	**BLM** - Approval of APDs and SNs on Federal leases. (3162.3-1, Onshore Oil and Gas order No. 1) **USACE** - 404 General permit if access roads cross perennial streams **FWS** - Review of EA/EIS for Biological Opinion	**MBOGC** - Federal APD (for record purposes only) **SHPO** - Review under the National Historic Preservation Act (NHPA) regarding protection of cultural/historic resources
Right-of-Ways (ROW)	**BLM** - Approval of ROWs on BLM-administered surface lands	**DNRC/TLMD** - Approval of ROWs on State Trust lands **Surface Owner** - Agreement of ROWs under Surface Owner Agreement **SHPO** - Review under the NHPA
Building a Gas Compressor Station on a Federal lease	**EPA** - Clean Air Act (CAA)—(42 U.S.C. 7401, *et seq.*) Air Quality Permits within the exterior boundaries of tribal lands **BLM** - Approval when facility is located on BLM administered surface	**SHPO** - Review under the NHPA **MDEQ** - Permit Determination ARM 17.8.743
Construction (>1 acre)	**BLM** - Approval when activity is located on BLM administered surface, including private surface over federal minerals.	**DNRC** - Approval on State Trust Lands **MBOGC** - Approval on private surface via approved drilling permit **MDEQ** - General Storm Water Permit (Administrative Rules of Montana [ARM] 17.30.11, >1 acre)
Discharge of Dredged or Fill Material	**USACE** – discharge of dredged or fill material into waters of the U.S.; Section 404 permit	**MDEQ** - MPDES General Discharge permit **MDEQ** - 401 Discharge Certification under the CWA and Montana Nondegradation Rules (ARM 17.30.701 *et seq.*)
Hazardous Waste Disposal		**MDEQ** – RCRA Waste Disposal—Hazardous Waste Management Act (75-10-401, MCA (ARM 17.53.101)
Drilling Mud and other Solid Waste Disposal	**BLM** - Approval via APD or SN for federal actions	**MBOGC** - RCRA-exempt Solid Waste Disposal (ARM 36.22.1105) **MDEQ** - Solid Waste Management Act (75-10-201, MCA) (ARM 17.50.501)
Disposal of Produced Water		
Injection	**EPA** - Underground Injection Control (UIC) Class V Permits for wells on both Federal and State lands. UIC Class II and V Permits for Indian Reservations **BLM** - Permit under Onshore Order No. 7 for water from federal wells	**MBOGC** - Oversee UIC program for Class II wells (ARM 36.22.1401)(82-11-101, MCA)

TABLE 1-2

PERMITTABLE ACTIVITIES FOR CBNG DEVELOPMENT

Permittable Activity	Federal Agencies	State Agencies
Infiltration Pit	**BLM** - Permit under Onshore Order No. 7 for water from federal wells	**MBOGC** - Infiltration Pit Permit for construction and operation **MDEQ** - Montana Pollutant Discharge Elimination System (MPDES) Permit (ARM 17.30.1301 – 1426)) and 401 certification for on-drainage pits **MDEQ** - Groundwater discharge permit
Evaporation/Storage Pit	**BLM** - Permit under Onshore Order No. 7 for water from federal wells	**MBOGC** - Earthen Pit or Pond Permit for the construction and operation **MDEQ** - MPDES Permit and 401 certification for on-drainage pits.
Discharge to Surface Waters (Treated or Untreated)	**EPA** - Oversight on NPDES permits and 401 certifications issued under CWA. On tribal lands, issues NPDES permits and 401 certifications **BLM** - Permit under Onshore Order No. 7 for water from federal wells	**MDEQ** - MPDES Permit and 401 certification
Beneficial Use	**BLM** - Permit under Onshore Order No. 7 for water from federal wells	**DNRC/Water Resources Division/Water Rights Bureau** - Issue water rights to allow beneficial use of groundwater and surface water (85-2-310 to 312, MCA)

Issues

Statewide Document

This section presents planning issues identified through the public scoping process held in January 2000 and the BLM and state planning activities. The issues raised were in relation to CBNG development and were included in the initial Statewide Document.

Air Quality and Climate

- Reduction in visibility occurring to the Northern Cheyenne Indian Reservation PSD Class I airshed from emissions
- Air quality impacts from oil- and gas-related activities
- Dust and emissions associated with road and drill pad construction, drilling operations, production, and compression
- Creation or release of harmful gases (hydrogen sulfide) and venting
- Consistency with the air quality model currently being developed for the Powder River EIS through the BLM Buffalo Field Office, Wyoming
- Release of greenhouse gases and effect on global warming
- Changes in ambient air quality and how this relates to objectives for minimizing regional haze based on the "Regional Haze Rule"
- Changes in climate associated with CBNG development

Cultural Resources

- Avoidance of direct and indirect disturbances to cultural resources may precipitate the development of targeted inventory and evaluation strategies in the planning stages of field development
- Impacts on the qualities of a cultural resource site affecting its eligibility for the NRHP
- Increased access for oil and gas exploration and development may result in inadvertent, indirect, and cumulative effects to cultural resources

- Identification of specific districts or localities in which oil and gas development may be incompatible with existing cultural values
- Identification of areas of critical environmental concern

Geology and Minerals

- Re-establish hydrologic balance and functionality after CBNG development so that adjacent or nearby coal companies can recover their bonds and determine effects on aquifer reconstruction in coal mine areas
- Discharge of CBNG -produced waters could affect new coal mines if entering the mine permit boundaries
- Effects on oil and gas development from other resource protection measures
- Loss of methane resource because of venting from coal mines
- Drainage of methane from federal minerals from offsetting state and private wells
- Quantity of methane recovered
- Effect of over-pumping CBNG water on gas recovery
- Subsurface coal fires
- Potential loss of coal production due to CBNG development

Hazardous Materials and Waste Management

- Use of hazardous materials and potential for misuse as a part of CBNG development

Hydrology

Groundwater

- Produced water quality and appropriate beneficial reuses
- Drawdown of aquifers and drying up of natural springs due to CBNG production
- Appropriate water management alternatives
- Water quality impacts
- Water rights conflicts
- Changes in pumping rate and cumulative drawdown due to CBNG development
- Impacts on down- and up-gradient water resources in both confined and unconfined aquifers
- Long-term effects of CBNG pumping on aquifer recharge and groundwater resources
- Effects on DNRC established Powder River Basin Controlled Groundwater Area
- Shallow (Class V) and deep (Class II) injection of produced water opportunities

Surface Water

- Effect of high sodium adsorption ratio (SAR) and increased flow rates on eroding stream channels
- Impacts on water quality from produced water
- Impacts on biota from water quality changes
- MPDES discharge analysis for CBNG -produced waters
- Cumulative impacts on water quality and quantity
- Impacts on irrigated cropland

Indian Trust Resources and Native American Concerns

- Unique Native American concerns and social impact on Native Americans
- The effects of discharged water on agriculture, fishing, hunting, and gathering of native and sacred plants as they relate to traditional values held by the tribes
- Protection of Indian trust assets with regard to resource drainage and reduction of usable assets
- Water quality preservation agreement with the Northern Cheyenne
- Effects to reservation PSD Class I area classification and nonattainment area
- Impacts on sites with traditional cultural importance to Native Americans in areas on and adjoining the reservations
- Increased use of public facilities and services on reservations
- Cultural and socioeconomic impacts on tribal members associated with CBNG development

Lands and Realty

- Construction effects from drilling, roads, pipelines, and water disposal facilities
- Infrastructure needed to accommodate CBNG development would require numerous road, powerline, and pipeline ROWs

Livestock Grazing

- Impacts on grazing lands from discharge of high salinity water
- Effects on livestock and ranching operations from the increased availability of water
- Displacement of grazing lands from the development of CBNG well pads and loss of natural forage
- Change in vegetative communities to more salt-tolerant species that are generally not preferred by livestock

Paleontological Resources

- Impacts from vandalism and unpermitted collectors as a result of increased access to remote areas
- Impacts on paleontological localities from oil and gas development

Recreation

- Effects on hiking, hunting, and other recreational activities from CBNG development
- Displacement and disturbance of wildlife and habitat will affect hunting, hiking, and other recreational activities

Social and Economic Values

- Increased levels of background noise and what noise mitigation would be conducted
- Impacts on social service agencies and local economics from increased population
- Decreased land values
- Escalated real estate prices
- Agricultural job loss
- Economic effect on local communities, including potential increased wage income, lower unemployment, increased local business, and potential costs of a "boom and bust" scenario
- Cost to residents from potential CBNG production affects on springs, livestock watering, and domestic water
- Social structure impacts through direct impacts on the local economy
- Revenue associated with the amount of methane recovered
- Tax revenue to local, state, and federal entities
- Effects on local economies and lifestyle from royalties to the state and federal government
- Royalties to local landowners who own mineral rights and surface disturbance payments to landowners who do not own mineral rights
- Lack of royalties or tax revenues available for Tribes from non-Indian oil and gas leases.
- Benefits from more abundant clean energy
- Effect from Wyoming CBNG development (cumulative)
- Economics of mitigation strategies
- Socioeconomic effect from lowering the water table
- Quantity of economical oil and gas resources and market implications
- Effects to agricultural productivity from SAR levels
- Effects to agriculture from air, soil, and water contamination
- Private surface owner notification prior to work
- Mechanism needed for land owner input on drilling, and leasing and mineral estate issues

Environmental Justice

- Make distributive justice analysis part of the public comment and decision process
- Northern Cheyenne Tribal Government's reliance on operator lease fees from tribal ranchers and irrigators operating on private and reservation lands

Soils

- High sodium effects: dispersion of soil colloids, reduced water infiltration, vegetative composition and population changes, mud pits and bogs, change in crop production yields, and changes in crops grown because of salinity tolerance levels
- Effects on soils from surface discharge flow changes: erosion on stream banks and in ephemeral drainages

if these are the discharge points (increased erosion where dispersion occurs)

- Effects on irrigated soils: changes in salt content in soil profile, changes in salt composition, saline seeps downgradient from irrigated soils, dispersion of soil colloids (reduction of soil permeability and increased erosion), and changes to micro-organism populations and composition
- Development effects: disturbance during drilling at pads (exposure to wind and water erosion), and road development (loss of soil used to develop road beds, and packing soil in undeveloped roads, leading to wind erosion)
- Effects on irrigation and crop management practices: addition of additional water for leaching fraction, potential for water logging soils, modification of irrigation systems, change in cropping equipment, and effects on crops
- Effects from land subsidence and disturbance

Vegetation

- Effect of surface discharge of high sodium or SAR water on native vegetation species that are salt intolerant, as well as on streamside vegetation
- Change in vegetative communities to more salt-tolerant species
- Loss of surface vegetation from construction
- Invasion of exotic and noxious plant species in disturbed areas
- Loss of plant productivity from development
- Protection of grasslands within the Powder River Basin
- Agricultural land withdrawal for CBNG production

Special Status Species

- Mitigation measures or avoidance needed to manage and protect candidate and sensitive species
- Loss of threatened and endangered species from development

Visual Resource Management

- Visual degradation from construction of production facilities, roads, powerlines, and pipelines
- Visual pollution

Wilderness Study Areas

- Effects on wilderness study areas from CBNG exploration and development

Wildlife

- Impacts from infrastructure development and increased human disturbance on wildlife habitat availability, quality and integrity, escape habitat, and management plans of MFWP
- Fragmentation of wildlife habitat
- Effects from water availability, quality, and quantity
- Loss of animals from hazards to the habitat, such as vehicles, equipment, and increased human access
- Effects on major waterways, such as the Tongue and Powder rivers, and to aquatic ecosystems, including fisheries
- Effect on migration patterns
- Change in vegetative communities to species that are generally not preferred by wildlife
- Effects from increased noise levels
- Effects from powerlines

SEIS

The following issues were identified during the public scoping process held in August and September 2005. The issues raised were in relation to CBNG phased development. These issues have been expressed in the form of questions.

Air Quality/Climate

- How will air quality, including visibility, be protected and mitigated, especially when considering all existing and proposed sources within the region? Concerns include general air quality, visibility, and potential adverse effects to public health from cumulative emissions of fine particles and fine particle precursors.
- How will air quality, including visibility, be protected within the Northern Cheyenne Indian Reservation airshed and other Class I airsheds?
- How will impacts on water chemistry be prevented in high altitude lakes with little acid neutralizing capacity?

- How will potential for fires from the migration of methane be avoided?
- What additional impacts will the TRR have on regional air quality?

Cultural Resources

- How will culturally important springs and other traditional cultural properties be affected and protected? These include all traditional cultural properties identified by the Northern Cheyenne Tribe as important such as the Rosebud and Wolf Mountains Battlefield sites and Northern Cheyenne Homestead sites in the Tongue River Valley.
- What traditional cultural properties in the RMP areas may be affected by CBNG development, and how will they be managed?

Native American Concerns

- How will unique environmental, social, economic, and cultural impacts to Native Americans be addressed by phased development?
- How will phased development provide an economic base to benefit tribal members, while not leading to another boom-and-bust cycle?
- How will subsistence hunting, fishing, and gathering be affected and protected?
- How will phased development help BLM to fulfill its Native American treaty trust obligations?
- How will phased development provide protection to tribal reserved water rights?
- How will phased development include coordination and consultation with tribal representatives?

Oil and Gas

- How will phased development be structured to address the national supply and demand situation and reduce U.S. dependence on foreign energy resources?
- How will RMP or landscape-scale effects be addressed by phased development?
- How will lease stipulations be used to mitigate for effects from phased development?
- How will phased development be structured to minimize infrastructure development (to reduce both costs and impacts), including coordination with neighboring landowners?
- How will reclamation and restoration be addressed by phased development?

Phased Development

- How will phased development be planned to account for and protect other resources?
- How will resource impacts from development and other CBNG activities be evaluated and addressed throughout the implementation of phased development?
- How will phased development minimize fluctuations in populations, air quality impacts, overburdening of infrastructure and services, and increases in secondary development?
- How will drainage of federal gas resources and impacts to federal lessees be addressed or affected by phased development?
- What phased development implementation strategy or strategies will be included (e.g., restrictions on location [specific area or coal seam], timing, or number of wells)?
- Will more than one phased development alternative be addressed in the FSEIS/Amendment?
- How will phased development reduce impacts, improve mitigation options, or protect multiple-use of resources?

Socioeconomics

- How will social and cultural changes be addressed by phased development? Specific concerns include infrastructure and service costs borne by state, local, and tribal governments, increased population, social pathologies (crime, alcoholism, drug use, etc.), and environmental exploitation.
- How will revenues (income lessees and state and local taxes) be affected by phased development, and how will these effects differ for reservation and off-reservation communities?
- How will phased development affect jobs, job security, local economy, and farming and ranching activities, and how will these effects differ for reservation and off-reservation communities?

Vegetation

- How will phased development address impacts to and reclamation of sagebrush steppe and grassland ecosystems?
- How will phased development account for the relatively slow vegetative response to changes in groundwater or surface water characteristics?
- How will phased development address the spread of non-native species in affected areas?
- How will phased development affect medicinal and ceremonial native plants important to Native Americans?

Water Resources

- How will produced water be managed by phased development?
- How will groundwater impacts be addressed by phased development? Concerns include groundwater drawdown in area or neighboring aquifers, effects on drinking water and stock watering wells, natural springs, and approved water rights.
- How will phased development address surface water effects and mitigation? Concerns include the consequences of changing surface water quality and transforming ephemeral or intermittent streams into perennial water bodies.
- How will effects from development outside the Planning Area be addressed by phased development?
- How will water well mitigation agreements mitigate the effects of aquifer drawdown and methane migration?
- How will phased development affect surface and groundwater quality?

Wildlife

- How will phased development address impacts on wildlife (particularly fish and other aquatic species) and habitat from changes to water quality?
- How will phased development address impacts (both site-specific and at the RMP, landscape, or ecosystem scale) on terrestrial wildlife species (and associated habitats), including song birds, burrowing owls, and bald eagles, but especially sage-grouse and prairie dogs? Particular concerns included habitat fragmentation and cumulative effects from development outside the Planning Area (especially the Wyoming PRB) and the ability to assign and quantify impacts from various anthropogenic influences.
- How will phased development address potential effects on big game and other subsistence wildlife populations relative to tribal hunting and fishing rights?
- How will phased development affect ESA-listed or potentially listed species?

Data Gaps

The FSEIS planning process will incorporate relevant new data collected since the spring of 2002 to update information presented in the Statewide Document, as needed, to meet the requirements of the Court's decision. BLM will incorporate these new data to address the topics identified by the Court and during public scoping, evaluate project effects from phased development alternatives, and analyze significant new environmental information relevant to environmental concerns and having bearing on alternatives or their impacts.

CHAPTER 2

ALTERNATIVES

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CHAPTER 2: ALTERNATIVES

Introduction

The Council on Environmental Quality regulations require an environmental impact statement (EIS) "rigorously explore and objectively evaluate all reasonable alternatives...." This chapter presents in detail the No Action Alternative (existing coal bed natural gas [CBNG] Management) and seven action alternatives for managing oil and gas resources—specifically CBNG exploration and production—throughout the Planning Area, which includes the Bureau of Land Management's (BLM's) Powder River and Billings Resource Management Plan (RMP) areas. Other alternatives were considered but eliminated without detailed analysis. A description of these alternatives and reasons for elimination are provided in the Alternatives Considered But Not Analyzed in Detail section.

This chapter is presented in five sections: Alternatives Development, Alternatives Considered But Not Analyzed in Detail, Management Common to All Alternatives, Management Actions Specific to Each Alternative and Comparison of Impacts.

Alternatives Development

The purpose of developing and presenting alternatives is to allow the decision maker an opportunity to address and resolve issues recognized during the scoping process. Alternatives meet the purpose and need for doing the plan and balance ways to address different resource issues. The resolution of key issues forms the framework of an alternative, with the resolution of lesser issues included around the alternative's central idea. This section describes how those key issues led to the development of the alternatives. The development of alternatives for this EIS centered on addressing regulatory issues in seven general areas:

- Air quality
- Coal mines
- Coal bed methane
- Hydrology
- Realty
- Indian trust resources
- Environmental mitigation

Although other relevant issues were considered, these key issues played a major role in defining the alternatives to be analyzed in detail.

Air Quality and Climate

Alternatives were developed by considering potential changes in ambient air quality from CBNG activities, such as reduced visibility, air quality emissions, dust emissions and harmful gases. Alternatives vary by limiting the number of wells connected to each compressor, the type of fuel required to power compressors (diesel, electric, or gas-fired) and whether noise suppression measures would be required. Potential air impacts, both project related and cumulative, were modeled for Alternatives A, B, C, D and E under the 2003 Final EIS. A new air quality model was conducted for this Final SEIS (FSEIS) to evaluate potential project and cumulative air impacts for Alternatives E, F and H. Potential air impacts for Alternative G were not modeled, as the only difference between Alternatives F and G is that Alternative G has 65 percent fewer wells.

Following the Draft Supplemental Environmental Impact Statement (DSEIS, BLM 2006), a Supplemental Air Quality Analysis (SAQA, BLM 2007) was prepared to augment the analysis conducted for the DSEIS. The SAQA provided additional information and analyses regarding the level of CBNG development with the potential to impact air quality within the Powder River and Billings RMP areas. It includes an analysis and comparison of the potential for CBNG development to impact air quality under different air quality emission rates under Alternative

What has Changed in Chapter 2 Since the DSEIS?

Chapter 2 lists the alternatives development process and describes the features of each alternative in detail. Updates include a general description of the Supplemental Air Quality Analysis, revisions to the preferred alternative and tables 2-2 and 2-3, as well as edits and clarifications. The preferred alternative has been revised based on public comment and agency collaboration. The preferred alternative includes revised air and wildlife screens. Tables 2-2 and 2-3 were revised based on the changes to the preferred alternative Table 2-2 is a management comparison of alternatives for exploration and development of CBNG; table 2-3, compares impacts of alternatives.

H, the preferred alternative. It also included a revised air quality screen that replaces the air quality impact screen from the DSEIS. The information contained within the Supplemental Air Quality Analysis expands on the air quality information presented in the DSEIS and the Air Quality Technical Support Document (BLM 2007). An Analysis of climate change has been added to the to the Air Quality and Climate sections of the FSEIS. Best management practices (BMPs) for controlling methane emissions (greenhouse gases) are identified as part of the BMPs available under the preferred alternative.

Coal Mines

The alternatives address buffer zone requirements around active coal mines, as well as the ability for adjacent or nearby coal companies to recover bonds and determine the effects on aquifer reconstruction. Alternatives also include CBNG water discharge affecting new coal mines, the effects on oil and gas development, loss of coal production resources from CBNG development, loss of methane resources because of venting and subsurface coal fires. Alternatives vary by the use of a buffer zone around active coal mines.

Coal Bed Methane

Restrictions on CBNG exploration and production activities were considered in developing the alternatives. Alternatives A through E vary by restrictions such as directional-drilling requirements; the number of coal seams produced per well bore and chronological coal seam development. Whether a Plan of Development (POD) is required in consultation with tribes, surface owners and other agencies is also addressed differently under each alternative. Other matters considered are drainage of methane from federal minerals by nonfederal wells; methane quantities; varying the amount of development based on the reasonably foreseeable development (RFD) range (low-high); the effects to groundwater from over-pumping water and the use of adaptive management. Alternatives F, G and H vary restrictions such as the number of federal producing CBNG wells based on ranges from the RFD, restricting the number of federal CBNG applications for permit to drill (APDs) that could be approved per year; varying the amount of development on a watershed-specific basis; use of adaptive management

Hydrology

Hydrology issues used in developing alternatives include inspection, treatment, storage and conveyance of CBNG-produced water. Short- and long-term effects on groundwater and surface water, impacts on water quality and water rights were considered. The alternatives differ by requirements for site-specific Water Management Plans, treatment, conveyance methods and the beneficial use of exploration and production water. In addition, alternatives F, G and H incorporate water screens that include potential limits on the volume of untreated water that can be discharged. Farmers, ranchers, irrigators, coal mines, light industry, transportation departments, local county governments and others could beneficially reuse production waters.

Realty

Realty matters center on requirements for right-of-way (ROW) corridors, powerline placement and use of or abandonment of roads from CBNG development. The alternatives vary by whether roads would be open to public use, closed and returned to a natural vegetative state, or maintained at the discretion of the surface owner. Other differences between the alternatives include requirements for buried powerlines, installation of raptor safety equipment and multiple utility corridor use.

Indian Trust Resources

The Crow Tribe of Indians and the Northern Cheyenne Tribe are located within the Planning Area for CBNG development and therefore, were given special consideration with regard to potential impacts from off-reservation operations. Issues considered include the potential drainage of Reservation groundwater and CBNG by off-reservation wells, impacts to sacred sites and resources, water rights, water quality preservation agreements, stress to reservation infrastructure, cultural sites and socioeconomic status. To address these issues, the use of a federal buffer zone or consultation zone, as well as monitoring requirements, were included in various alternatives.

The Northern Cheyenne Tribe has proposed a series of mitigation measures, in which the BLM has incorporated into a table, a copy of which can be found in the Northern Cheyenne Mitigation Appendix attached to this EIS. The BLM has considered these measures for implementation and has developed corresponding requirements that are included in Alternatives E, F, G and H.

Environmental Mitigation

Environmental mitigation measures to address resources were presented in the scoping comments. The mitigation measures have been incorporated into the management actions of the various alternatives. These include commercially harvesting trees within ROWs; implementation of high fire danger restrictions; road use enforcement; road placement restrictions; wellhead camouflage requirements; conducting wildlife surveys; and the use of early successional species along with appropriate early and late seral stage native species for revegetation. The environmental mitigation measures are applied to the various alternatives based on their general themes for either protection of existing resources, emphasis on CBNG development and phasing of CBNG development.

Alternatives Considered But Not Analyzed in Detail

The alternatives below were considered for resolving planning questions or issues, but were not analyzed in detail because of technical, legal, or other constraints.

Leasing

BLM oil and gas leasing decisions and lease stipulations, including those applicable to CBNG, were previously analyzed in the BLM 1992 *Final Oil and Gas RMP/EIS Amendment* (BLM 1992). Those decisions were approved in the project's *Record of Decision* (ROD) published in February 1994. During that process, the public was invited and encouraged to participate. Analyzing new federal lease decisions such as closing federal areas of oil and gas estate in the Powder River and Billings RMP areas, are therefore beyond the scope of this plan. The existing lease stipulations approved in the 1994 ROD continue to be applicable to all CBNG development and have been included in Table MIN-5 of the Minerals Appendix. CBNG is part of the oil and gas estate. Existing oil and gas leases include the right to explore and develop CBNG. Issuing separate leases for conventional oil and gas and separate leases for CBNG would require a regulatory change.

The purpose of this document is to analyze federal CBNG phased development in accordance with the U.S. District Court's directive for supplementing the BLM 2003 Final Montana Statewide Oil and Gas EIS and Proposed Amendment of the Powder River and Billings RMPs (Statewide Document). The alternatives analyze different levels of producing CBNG wells between the low range in Alternative A to the high range in alternatives E, F and H. The alternatives also analyze different mitigation measures or restrictions that BLM can impose as requirements with approved permits. In addition, Alternatives F, G and H analyze phased mechanisms that BLM can use to affect the pace and place of CBNG development on federal leases, as well as the density and intensity of cumulative CBNG development. Mitigation measures and a process to evaluate projects to determine if restrictions are necessary to alter the pace or place of federal development are included in alternatives F, G and H (the Preferred Alternative). The evaluation would be conducted during the permit review process and during the production phase.

Bonding

Establishment of bond amounts specifically for CBNG development activities that cover the full cost of CBNG development. This alternative is not analyzed in detail because the MBOGC and BLM regulations set minimum amounts of bonding required before approving drilling permits. The regulations allow agencies to raise the bond amount required depending on such factors as the number and type of wells, type and amount of reclamation necessary and operator history. Bond increases cannot exceed the total of estimated costs of plugging and reclamation, the amount of uncollected royalties due and monies owed because of outstanding violations.

Omega Alternative

The Omega Alternative to drill a large-diameter well through the coals and from the base of that shaft to directionally drill upward into the various coal seams in a circular pattern is an experimental technology not yet proven for CBNG. If this technology becomes viable for CBNG extraction in the future, further consideration would be given to it.

Alternate Sources of Energy

The purpose of this FSEIS is to consider federal CBNG phased development. Considering alternate sources of energy such as wind power and fuel cells is therefore beyond the scope of this FSEIS.

Re-Injection of Produced Water into the Same Aquifer Alternative

Re-injection of produced formation water is an accepted practice in conventional oil fields but its use

in CBNG fields would be counterproductive if the produced water was re-injected or could migrate into the CBNG producing formation. In conventional oil fields, operators have re-injected produced water since the 1920s to help maintain reservoir energy and to increase ultimate production efficiency, or to move oil preferentially to producing wells. When produced water is re-injected, original reservoir pressures are maintained; this can significantly increase the percentage of original oil in place that is produced before the field's economic limit is reached (Thomas et al. 1987). Re-injection can also sweep oil out of the reservoir toward producing wells in a waterflood, also increasing production efficiency. In these scenarios, water production is neither desired nor absolutely necessary; it is a nuisance that can be minimized with standard engineering practice. In the history of many oil fields, oil is produced water-free for months or even years before water is seen in producing wells.

In CBNG production, formation water must be produced before reservoir pressures are sufficiently reduced for the adsorbed methane to be liberated. Water production is unavoidable and pre-requisite to CBNG production. As water is produced from the coal seam, the pressure in the seam is reduced. Research by the BLM's Casper, Wyoming, Field Office suggests that methane production begins after 20 percent of the virgin reservoir pressure is depleted; significant production does not begin until 40 percent of the pressure is depleted (Crockett and Meyer 2001). Work by Jones et al. (1992) corroborates this relationship. If methane production is directly related to depletion of reservoir pressure, then re-injection of produced water within the confines of the CBNG field will directly result in the decrease of methane production. Re-injection of CBNG-produced water into the producing formation is not a reasonable option for management of produced water. When and if this technology becomes viable, a more detailed analysis would be conducted for further consideration.

It would be reasonable to inject produced water into non-productive coal seams that were geologically separated from the CBNG field. Separation could be the result of faulting or erosion, isolating coals in the injection area even from stratigraphically equivalent productive coal seams in the CBNG field. Under Alternative B the injection of produced water into either non-productive coal seams or aquifers with water of lesser quality is analyzed.

This type of injection results in preservation of the produced water resource, whether of high or low quality. The permit process could mitigate impacts to groundwater so that the quality of the injected water is matched to the quality of the formation water in the prospective injection zone.

Recently there have been discussions suggesting the mandatory injection of all CBNG-produced water. In fact, a petition was forwarded to the Montana Board of Environmental Review (BER) for consideration of this topic. In preparation of this board debate, a report entitled the "Potential Effects to Ground Water Systems Resulting from Subsurface Injection of CBM Production Water" was drafted by the Montana Bureau of Mines and Geology (MBMG) (Wheaton and Reddish 2005). The report states that, overall, the approach of injecting water into Fort Union Formation aquifers of the Powder River Basin has not been widely tested. Areas where favorable conditions exist appear to be limited to approximately 9 percent of the total area. Mandating injection does not mean it is technically feasible, regardless of economics. In some areas that have suitable aquifers, injection may be technically and economically feasible, as well as a means of conserving the water resource. Injection cannot, however, be regarded as appropriate in all settings. Further, mandated injection may force the use of the deeper Madison Group geologic formation that has water of lower quality than the CBNG produced water. If CBNG produced water was injected into the Madison formation, the quality of the water might make it unsuitable for beneficial uses without treatment.

Phased Development (other than Alternatives F, G and H)

Comments received during the public scoping period varied substantially in their interpretation of what constitutes "phased development." While BLM has analyzed phased development under alternatives F, G and H, several proposed elements of phasing were not analyzed in detail. Those proposed elements and BLM's rationale for not analyzing them in detail are addressed below.

Fully develop one area while resting others. Subsequent development occurs as earlier areas are completed and restored.

While BLM could authorize development for one watershed or specific area at a time, the purpose would be defeated by state and private development occurring in all areas or specific areas, which is not controlled by BLM actions. In the FSEIS, Table Min-1 in the Minerals Appendix indicates that more than one half of the wells projected in the RFD would be State approved (9700 State approved to 8400 Federal

approved). The BLM does not control the approval or drilling of the state and private wells. This is illustrated by the number of state and private wells that have been drilled while the BLM was preparing the Statewide Plan (BLM 2003) and the SEIS (as of January 2008, approximately 950 CBNG wells have been developed under State authorization in Big Horn County, the most active CBNG county in the planning area). In addition, BLM has contacted the Montana Board of Oil and Gas Conservation in regard to CBNG management. They state:

> "The Board of Oil and Gas has no underlying statutory authority to direct the development of oil and gas resources; those resources are managed by their owners. The Board does have a statutory mandate to prevent the drilling of unnecessary wells, prevent economic and physical waste, and protect the correlative rights of competing mineral owners by establishing well location and set-back rules, and reservoir spacing rules. We do not envision the implementation of a management technique that would be less protective of competing property rights and more likely to result in waste of natural gas, and the drilling of unnecessary wells."

Based on the projection of the number and location of wells, the mixed mineral ownership, and the statutory authority of the Montana Board of Oil and Gas Conservation it is reasonable to assume that development of state and private wells would not conform to specific areas identified for the development of federal wells. Therefore, it is not reasonable to fully develop one area while resting others followed by subsequent development in other specific areas when initial development areas are completed, because limiting state and private development to specific areas is not achievable.

> *Areas where CBNG development cannot avoid creating significant environmental impacts should be identified and closed to leasing. Those areas that require lease stipulations in order to reduce environmental impacts to an acceptable level should also be identified.*

The rationale for not analyzing oil and gas leasing is provided in this section (see "Leasing" above). The Preferred Alternative (H) uses adaptive management to help prevent significant effects. The Monitoring Plan in the Monitoring Appendix identifies resources to be monitored and BLM's management options should a threshold be met.

> *Consider a phased development alternative that allows for the development of only certain coal seams at a time. When the initial zones have been depleted, produced water from other coal seams, developed in subsequent development phases could be re-injected into these depleted coal seams by converting the original wells into reinjection wells.*

The rationale for not analyzing reinjecting produced water into the same aquifer is addressed in this section (see "Re-Injection of Produced Water into the Same Aquifer" above.

> *Stop issuing drilling permits during construction phases of other projects to reduce the effects of impacts associated with the other projects.*

Much of the development occurring in Montana occurs in a phased manner. Practical constraints, especially infrastructure to get the product out and state and federal permitting requirements all dictate industry's proposed development occur in phases.

Management Common to All Alternatives

Management common to all alternatives are the management practices for conventional oil and gas, as well as CBNG lease operations that are the same in each alternative.

Bureau of Land Management

The BLM has primary responsibility for managing the federally owned oil and gas estate. After lease issuance, operations may be conducted with an approved permit. Proposed drilling and associated activities must be approved before beginning operations. The operator must file an APD or Sundry Notice (SN) that must be approved according to (1) lease stipulations; (2) onshore oil and gas orders; and (3) regulations and laws. The steps required to obtain approval to drill and conduct surface operations are summarized in Appendix A of the 1992 Final Oil and Gas RMP/EIS Amendment and in the Minerals Appendix of the BLM's Big Dry Resource Management Plan/Environmental Impact Statement for the Big Dry Resource Area of the Miles City District (Big Dry RMP/EIS) (1995). The process described therein is common to all alternatives.

In addition, under requirements of the Clean Air Act (CAA) and the Federal Land Policy and Management Act (FLPMA), any activity the BLM authorizes (including oil and gas development) must comply with all applicable local, state, tribal and federal air

quality laws, regulations, standards, increments and implementation plans. Therefore, land use authorizations will specify that operating conditions (i.e., air pollutant emissions limits, control measures, effective stack heights, etc.) are consistent with the applicable air regulatory agency's requirements.

State of Montana

State agencies that have authority over oil and gas activities include the Department of Natural Resources and Conservation (DNRC), which includes the Montana Board of Oil and Gas Conservation (MBOGC), the Trust Land Management Division (TLMD) and the Water Resources Division; and the Montana Department of Environmental Quality (MDEQ). Each of these agency's roles and responsibilities were discussed in Chapter 1. Current oil and gas development is managed under the guidelines developed in the MBOGC's Record of Decision: Statewide Coal Bed Methane Exploration and Development (March 26, 2003; http://www.bogc.dnrc.state.mt.us/PDF/finalrod.pdf). This document outlines how to incorporate any necessary environmental review into its rules and permitting process in an effort to comply with the Montana Environmental Policy Act (MEPA). In conducting environmental reviews for new permits, MBOGC works with other state agencies that may become involved in the process.

Surface Use Agreements

Oil and gas operators on federal leases must submit certification that a surface use agreement (SUA) has been reached with surface owners of split estate lands. These are lands involving private surface overlying federal minerals.

BLM does not consider an APD or sundry notice complete until the federal lessee or operator has certified that an agreement with the surface owner exists, or the lessee or operator complies with Onshore Oil and Gas Order 1 (Instruction memorandum No. 2003-131). Compliance with Onshore Oil and Gas Order 1 requires the federal mineral lessee or operator to enter into good-faith negotiations with the private surface owner to reach an agreement for protection of surface resources and reclamation of disturbed areas, or payment in lieu thereof, to compensate the surface owner for loss of crops or grazing and damages to tangible improvements, if any. If such an agreement between the surface owner and lessee or operator could not be reached, a bond would be required to protect against covered damages in the absence of an agreement.

The Stockraising Homestead Act of December 29, 1916 (SRHA) (43 U.S.C. 299) and regulations at 43 CFR 3814.1(c) clearly limit covered damages to grazing and associated tangible improvements. The effective Onshore Oil and Gas Order 1 states that compensation is based on the law that reserved the mineral estate. It also states the amount of such a bond must be a minimum of $1,000 and be sufficient to: 1) pay for loss or damages; or 2) comply with the provisions of the law that reserved the mineral estate.

Water Well Mitigation Agreements

CBNG development has the potential to impact groundwater by decreasing the pressure within the coal aquifers (drawdown). As such, it is the subject of Montana Code Annotated 82-11-175, which was enacted by the Montana Legislature in 2003 and MBOGC Order 99-99. This order describes the authorities that pertain to CBNG development. A copy of the order is included as an appendix to the Water Resources Technical Report (ALL 2001b). The order outlines water rights issues, mitigation, monitoring plans and jurisdiction.

Montana Code Annotated (MCA) 82-11-175 requires CBNG operators offer a reasonable mitigation agreement to each appropriator of water who holds an appropriation right or a permit to appropriate groundwater. This requirement is in effect if the point of diversion is within 1 mile of the CBNG well, or 0.5 mile of a water source that is adversely affected by the coal bed natural gas well.

Mitigation agreements must address the reduction or loss of water resources and must provide for prompt supplementation or replacement of water from any natural spring or water well adversely affected by the coal bed natural gas well. An example water mitigation agreement is included in the Hydrology Appendix.

For development on federal minerals, BLM would require operators to certify that water well mitigation agreements for the proposed federal wells have been offered in accordance with MCA 82-11-175. These water mitigation agreements would also have to contain language addressing how an operator would respond to water wells being rendered unusable or unsafe due to methane migration and how health- and safety-related impacts would be monitored and mitigated.

3104 Bonds

Current regulations set minimum amounts (financial) of bonding required. BLM may require an increase to any bond (43 CFR 3104.5B), whenever it was determined the operator posed a risk due to factors including, but not limited to, the number and type of

wells, type and amount of reclamation necessary and operator history. The increase in bond amount can be to any level BLM specifies, but it cannot exceed the total estimated costs of the total estimated amount of uncollected royalties due, monies owed because of outstanding violations and estimated well plugging and reclamation costs.

Mitigation Measures

Management practices common to all alternatives include numerous mitigation measures categorized by resource topic. These mitigation measures are derived from current leasing stipulations, standard operating procedures and MBOGC field orders. A list of the mitigation measures considered common to all alternatives is provided in Table 2-1.

Not all mitigation measures are applicable under all leases; due to the variances between Federal, State and private surface and mineral ownership. MEPA compliance by state agencies may result in site-specific mitigation measures being developed that are not listed in Table 2-1. Specific mitigation measures to be applied depend upon the ownership of both surface and minerals and upon the land management agency and regulatory agency involved. The TLMD is the land manager for state owned lands; BLM is both land manager and regulatory agency on BLM-administered lands; and private land owners are managers of the private land. The Board of Oil and Gas is the regulatory agency for state and private lands. Note, current leasing stipulations are not being amended under this FSEIS, but can be found in tabular form in the Minerals Appendix, Table MIN-5.

Management Actions Specific to Each Alternative

Eight alternatives have been developed to evaluate the impacts related to the various development scenarios associated with CBNG exploration and production. Each alternative represents a different approach for resolving the issues identified during scoping. Alternative A, the No Action Alternative, would continue existing management. Alternative B would allow CBNG development while emphasizing resource protection. Alternative C would emphasize CBNG development with minimal environmental restrictions. Alternative D would encourage CBNG exploration and development while maintaining existing land uses. Alternative E would allow for CBNG exploration and development while sustaining resource and social values and existing land uses. Alternatives F, G and H would allow exploration and phased development of federal CBNG by applying multiple screens and mitigation measures designed to protect the other resource values through the pace and place of CBNG development. Alternative H would allow for exploration and development coupled with a monitoring feedback loop that would provide information for adaptive management decisions.

In Alternatives A through E, crucial habitat for wildlife would be managed in accordance with the current BLM policies and with the use of mitigation measures outlined in the FSEIS and Wildlife Monitoring and Protection Plan (WMPP). In Alternatives F and G, conditions would be placed on any proposed CBNG federal mineral development within crucial sage-grouse habitat areas with the goal of avoiding the displacement of sage-grouse from crucial habitat areas. For Alternative H, results of recent research related to sage-grouse would be applied. In addition adaptive management would be applied to sage-grouse habitat, allowing BLM to alter surface disturbance thresholds, adopt new BMPs and work with the state to apply BMPs universally to protect sage-grouse habitat.

Each alternative was structured to stress different development emphasis, such as resource protection, CBNG development and existing land uses.

TABLE 2-1

MITIGATION MEASURES COMMON TO ALL ALTERNATIVES

(Applies to BLM Managed Oil and Gas Estate)

Resource Topic	Mitigation Measure
Air Quality	Access roads, well pads and production facility sites constructed on soils susceptible to wind erosion will be appropriately surfaced to reduce fugitive dust emissions
	Dust inhibitors will be used as necessary on unpaved collector, local and resource roads to reduce fugitive dust emissions to the air and resources adjacent to the road
Cultural Resources	Cultural resource reviews/surveys will be conducted as required by BLM or TLMD prior to the commencement of construction or other surface disturbing activities authorized by BLM or TLMD. Results of the survey will be presented as part of the permit review or approval process. Decisions regarding relocation of proposed access roads or well pads, data recovery and excavation will be made to protect the cultural or historical sites
	Surface occupancy and use is prohibited within sites or areas designated for conservation use, public use, or sociocultural use
Geology and Minerals	No Surface Occupancy stipulations are placed on new oil and gas leases which are issued for lands that have existing coal leases
	Reclamation is required on areas of surface disturbance during the production and abandonment phases of development
Hydrological Resources	Water well and spring mitigation agreements will be used to facilitate the replacement of groundwater lost to drawdown. Replacement water may require supply from offsite sources
	Montana's water quality standards for the Tongue and Powder Rivers are being challenged by court actions that are not yet resolved. The states of Montana and Wyoming are in negotiations on appropriate state-line standards and the methods used to manage CBNG discharges in Wyoming to meet the standards that are eventually adopted.
	Oil and gas leases issued for lands that contain floodplains, wetlands, or riparian areas have stipulations regarding No Surface Occupancy (NSO) attached.
Lands and Realty	Surface disturbance on federal lands will be reclaimed following the BLM-Miles City Field Office (MCFO) seeding policy (BLM 1999c) or future revisions
	Roads and utility ROW impacts experienced prior to reclamation are mitigated by requirements for repair or replacement in the site-specific review, or through compensation for actual damages
	Property damage would be repaired or replaced according to landowner agreements at the operator expense
	Surface owners or surface lessee will be consulted regarding the location of new roads and facilities related to oil and gas lease operations
Livestock Grazing	Repair or replace damaged gates and fences according to landowner requirements at operator's expense
	When working on or near grazing lands, project-related construction equipment and vehicle movement will be minimized to avoid disturbance of grazing lands
	Responsibilities for fence, gate and cattleguard maintenance; and noxious weed control will be defined in APDs, Agency Approvals, or ROW grants
	Facilities will be placed to avoid or minimize impacts on livestock water

TABLE 2-1

MITIGATION MEASURES COMMON TO ALL ALTERNATIVES

(Applies to BLM Managed Oil and Gas Estate)

Resource Topic	Mitigation Measure
Paleontological Resources	The BLM APD contains guidance for notifying and mitigating damage to paleontological resources discovered during oil and gas construction activities. Limitations include restricted use of explosives for geophysical exploration, monitoring requirements and work stoppages for discovered damaged resources
	Surface occupancy and use is prohibited within designated paleontological sites
	The Bridger Fossil Area is a designated Area of Critical Environmental Concern (ACEC) is not available for oil and gas development
Recreation	Surface occupancy and use is prohibited within established recreation areas and undeveloped recreation areas receiving concentrated use on lands administered by BLM
	Exploration activities would be coordinated for timing to minimize conflicts during peak use periods
Social and Economic Values	Economic impacts on groundwater users would be mitigated by the mandatory offering of water well and spring mitigation agreements
Soils	Construction activities will be conducted in accordance with the BLM Gold Book (USDI and USDA 2006; http://www.blm.gov/bmp/goldbook.htm) requirements
	Federal leases with slopes in excess of 30 percent will be required to obtain approval for occupancy from the BLM based on mitigation of erosion, surface productivity after remediation and mitigation to surface water quality
	Riparian zones will be protected by federal lease stipulations and permit mitigation measures
	Lease roads and constructed facilities will be limited based on the Surface Use Program in the APD
	In areas of construction, topsoil will be stockpiled separately from other material and be reused in reclamation of the disturbed areas
	Unused portions of the drill location will have topsoil spread over it and reseeded
	Construction activities will be restricted during wet or muddy conditions
	Construction activities will be designed following Best Management Practices (BMPs) to control erosion and sedimentation
	If porous subsurface materials are encountered during drilling, all onsite fluid pits will be lined
	During road and utility ROW construction, surface soils will be stockpiled adjacent to the sides of the cuts and fills
	Stream crossings will be designed to minimize impacts and impede stream flow
	Erosion control measures will be maintained and continued until adequate vegetation (defined by BLM on a case by case basis) cover is re-established
	Water bars will be constructed on slopes of 3:1 or steeper
Solid and Hazardous Wastes	Solid and Hazardous wastes generated as a result of oil and gas lease operations will be disposed of in a manner and at a site approved by the appropriate regulating agency.
Vegetation	Site-specific surveys for Special Status Plant Species would be conducted prior to surface disturbance commencement

TABLE 2-1

MITIGATION MEASURES COMMON TO ALL ALTERNATIVES

(Applies to BLM Managed Oil and Gas Estate)

Resource Topic	Mitigation Measure
Vegetation (cont.)	The BLM Seeding Policy (Miles City BLM Seeding Policy, dated October 27, 1999(c)) and any future revisions will be followed for all reclamation and reseeding activities
	Vegetation will be removed only when necessary
Visual Resource Management	Surface occupancy and use is prohibited within designated Visual Resource management Class I areas
	All surface-disturbing activities and semi-permanent and permanent facilities in Visual Resource Management Class II areas require special design, including location, painting and camouflage, to blend with natural surroundings and meet the visual quality objectives of the classification
Wilderness Study Areas	Laws and regulations established to protect Wilderness Study Areas (WSA) prohibit leasing of designated WSA lands for resource extraction
Wildlife	An extensive list of no surface occupancy and no surface use stipulations by species is presented in the Wildlife section of Chapter 4. These stipulations limit and exclude use within designated distances from known species' specific nesting areas and habitat. Measures could also include Conditions of Approval, as authorized by IM-2005-069 for on-site and off-site mitigation for APDs and ROWs. After implementation of the BMPs, impacts to the wildlife resources will be evaluated through the use of the wildlife screen.
	Other restrictions governing development timing, controlled surface use and avoidance measures are listed in Table MIN-5 of the Minerals Appendix
Aquatic Resources	Surface occupancy and use is prohibited within 1/4 mile of designated reservoirs with fisheries

Alternative A—No Action (Existing Management)

This section describes the current management practices used by the BLM and the state to manage the exploration, development and operation of CBNG wells in the Planning Area.

The BLM issues oil and gas leases that include the right to explore for and develop CBNG. The Final Oil and Gas RMP/EIS Amendment allowed for the drilling of test wells and initial small-scale development of CBNG. Under existing management, APDs for CBNG wells would be approved on a case-by-case basis, only in specific geographic areas where little or no CBNG data is available. The APDs would only authorize the drilling and testing of wells and associated construction activities. CBNG production would not be authorized nor would the operator be allowed to discharge waters into State or U.S. streams or drainages. All current leasing stipulations regulating mitigation measures would be applied to new leases and enforced on current leases. APDs for CBNG exploration and testing would be considered for possible approval, on a case by case basis, under an evaluation criterion that would include, but not be limited to, areas where the following apply:

- The proposal is in conformance with the Powder River and Billings RMPs
- Data for coal, gas or groundwater does not exist
- Data for coal, gas or groundwater is limited
- Data for coal, gas or groundwater might be dated or unreliable
- Data for coal, gas or groundwater is only available from certain coal seams
- The proposed placement of wells would optimize data collection
- The well, if not productive, could be useful for monitoring

APDs for coal bed natural gas wells would not be considered for approval in areas where the following apply:

- The proposal is not in conformance with the Powder River or Billings RMPs

- Sufficient and accurate data exists for coal, gas and groundwater
- Other coal bed natural gas wells are being drilled
- Other coal bed natural gas wells are producing
- Monitoring wells are in place or not needed

Water produced during the testing phase would not have to be treated and would be contained at the well site in either a pit or a steel tank. The water would be available for beneficial use by industry (for example, pipelines, dust abatement) and landowners. Wells drilled on federal minerals would be shut-in or plugged after completion of the testing phase.

Coal seams targeted for exploration would be determined by industry and not by the government. Vertical wells producing from a single coal seam would be allowed. Vertical wells producing from multiple coal seams would not be required. Operators would be required, when technologically and economically feasible, to drill several wells from a single well pad, which may require directional drilling. The placement of wells would not be restricted through the use of buffer zones around active coal mines or Indian reservations.

Transportation corridors for vehicles would not be required; however, operators would be encouraged to use existing routes, corridors, or previously disturbed areas when feasible or as required by the surface owner. Powerlines would be either aboveground or buried according to operator plans. Placement of roads and powerlines or other utilities requiring ROW are subject to environmental review and agency approval. Diesel, electric, or gas-fired engines would power generators used during the testing phase of CBNG wells. The number of wells connected to each compressor would be dependent on the operator's development circumstances. Equipment would have to be removed at the end of the testing phase or at the time of abandonment. Areas of surface disturbance associated with lease operations would have to be reclaimed at the completion of activities in accordance with surface owner requirements. Upon abandonment, roads providing legal access to BLM-administered surface would be open to the public.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

This alternative would allow CBNG development while emphasizing the protection of natural and cultural resources.

The following measures would be required to reduce environmental impacts.

All generators and compressors would have to be powered by natural gas-fired engines. The number of wells connected to each compressor would be maximized to reduce the overall number of field compressors.

To the extent agency authority allows, buffer zones would be established around Indian lands and active coal mines. Until a reservation approves production of CBNG on their lands, a 2-mile buffer would be enforced around reservations in Montana. A 1-mile buffer would be enforced around active coal mines where no CBNG production would be permitted.

Water from exploration wells would be stored in tanks, or other approved non-discharging storage facilities. Water from producing wells would be injected into a different aquifer with the same or lesser quality water. Class V permits for injection of produced water with less than 3,000 milligrams per liter (mg/l) total dissolved solids (TDS) would need to be obtained from the EPA Region VIII. If the produced water has dissolved solids in excess of 10,000 mg/l, it would need to be disposed of via the Class II Underground Injection Control (UIC) program maintained by the MBOGC. Produced water between 3,000 and 10,000 parts per million (ppm) TDS can be disposed of in a Class II well permitted by MBOGC with concurrence from the Environmental Protection Agency (EPA). Regardless of the water quality or class of well, the produced water would not be injected into the same coal seam that the methane was being extracted from unless there was some form of geological separation to prevent migration of the injected water into the area of methane production.

There are several potential limitations to injecting all the water in this alternative. Since certain geological conditions are desirable for injection and they are not always present in the near surface, it is conceivable that in some cases deep injection into the Madison limestone would be required. Formations that are potential zones for injection may also have limited capacity to accept large volumes of water. Due to the high cost of injection and the uncertain success in disposing of all produced water over the life of a group of CBNG wells, injection has not yet been shown to be commercially viable for the CBNG industry in the Powder River Basin (PRB).

Co-location by spacing unit, of single-seam development wells on the same well pad would be required. Multiple seam completions in a single well bore would be encouraged to the extent technology permits. CBNG production could occur simultaneously from multiple seams or staggered over time from

separate seams. Directional drilling would be required for deeper coal seams to avoid excess surface use or disturbance.

Roads to wells and compressor sites would be limited to single lane width with turnouts. Exploration wells would not have permanent gravel access roads. Utilities would be placed along the road routes, using the transportation network as utility corridors. Powerlines would be buried in the utility corridors; no overhead lines would be permitted. Produced water pipelines and gas pipelines would be buried in the same trench when feasible. When the well had reached the end of its useful life, new access roads on BLM and state surface would be rehabilitated if closed.

The following paragraphs address environmental mitigation measures envisioned to reduce impacts on various resource topics.

During the construction of ROWs and roads, commercially valuable trees would be harvested and the proceeds paid to the resource owner. Long-term loss of commercial timber production on these lands would be negotiated with the TLMD and private landowners.

Use of CBNG-related roads would be limited to industry and enforcement would be increased through the use of additional fences and gates to reduce public access and overuse. This effort would help educate residents that these roads are not part of the public road network. Speed limits would be posted and enforced to reduce fugitive dust emissions. Road placement would be limited to tract boundaries where practical to reduce impacts on residential and agricultural lands.

Operators will be required to comply with agency imposed conditions during times of high fire danger. Such conditions may include restrictions on types of activities allowed, hours of operation and requirements for maintaining certain fire suppression equipment at the work site. Operators must maintain a current fire suppression plan.

To reduce noxious weeds from spreading during CBNG-related activities, operator's weed prevention plans must include measures to prevent the spread of weed seeds from any vehicle or equipment. Additionally, during reclamation activities, both native and non-native early succession plants, along with sterile cover crops, would be used for revegetation to provide a quick cover before noxious weeds can take root.

Wildlife surveys required by BLM would be conducted prior to the approval of APDs. Qualified wildlife biologists would conduct the surveys and results would be reported to Montana Fish, Wildlife, and Parks (MFWP) for consultation regarding avoidance and/or other wildlife protective measures.

Alternative C—Emphasize CBNG Development

This alternative would emphasize CBNG exploration and development with minimal restrictions.

Operators could use diesel engines with Best Available Control Technology (BACT) to reduce emissions. Operators would not be required to connect a minimum number of CBNG wells to a field compressor nor limit the number of field compressors delivering gas to a sales compressor.

Roads and utility corridors would be positioned to use existing disturbances as much as possible. Powerlines would be aboveground or buried per the operator's plans. Gas and water lines would be buried. Upon abandonment, new BLM and state surface oil and gas roads would be rehabilitated and closed.

Operators would not be required to drill directional or horizontal CBNG wells. Wells would be located by the operator and agencies would not require multiple wells to be located on the same well pad.

Water management would be based on a combination of beneficial use and surface discharge. Beneficial uses would include stock water, coal mine dust suppression, irrigation, constructed wetlands, domestic water supply, produced water as drilling fluid, de-icing of road aggregate storage piles, industrial needs and agricultural reuse. Surface discharge would be subject to MDEQ permit requirements, Montana Pollutant Discharge Elimination System (MPDES) and limitations established for discharge into identified watersheds. Water discharge via a transportation pipeline into a drainage system would not be required. The operator must obtain 401 Certification from the MDEQ if the disposal action needs BLM approval. Injection of produced CBNG water would not be required.

A CBNG production buffer zone would not be imposed around Indian reservations or coal mines.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

This alternative would encourage CBNG development while maintaining existing land uses and protecting downstream water consumers. The following paragraphs

address environmental mitigation measures envisioned to balance development with resource protection.

The number of wells connected to each compressor would be maximized to reduce the overall number of field compressors required. Natural gas engines with electric boosters would be required for all compression operations. Operators would be required, when technologically and economically feasible, to drill several wells from a single well pad, which may require directional drilling. Multiple seam completions in a single well bore would be encouraged. The transportation network also would serve as a utility corridor. Roads and utilities would be constructed with one way in and out. All powerlines and water and gas pipelines would be buried. Upon abandonment, new oil and gas roads on BLM-administered surface would be rehabilitated if closed. Roads would remain open or closed at the surface owner's discretion.

To the extent agency permitting allows, buffer zones for production would be established around Indian lands (2 miles) and active coal mines (1 mile). The buffer zone around Indian lands would remain in effect until the tribe approves production on its own lands.

All produced water (depending on water quality) would be treated prior to surface discharge or pumping into holding facilities such as impoundments, pits and ponds. Transportation of treated water for discharge would be via a constructed drainage system or pipeline to the nearest perennial watercourse if possible. The method of treatment is unrestricted, provided the effluent meets standards established by the MDEQ for downstream use. Beneficial use of produced water would be allowed and treatment would vary based on industrial, municipal, or agricultural uses such as power plant cooling water, coal slurry pipeline, field irrigation, livestock or wildlife watering, or municipal power turbines. The operator must obtain 401 Certification from the MDEQ if the disposal action needs BLM approval. Surface storage of produced waters would also require an MPDES permit issued by MDEQ.

Use of CBNG-related roads would be limited to industry and enforcement would be increased through the use of additional fences and gates to reduce public access and overuse. This effort would help educate residents that these roads are not part of the public road network. Speed limits would be posted and enforced to reduce fugitive dust emissions on BLM administered surface.

Operators will be required to comply with agency imposed conditions during times of high fire danger. Such conditions may include restrictions on types of activities allowed, hours of operation and requirements for maintaining certain fire suppression equipment at the work site. Operators must maintain a current fire suppression plan.

To reduce noxious weeds from spreading during CBNG-related activities, operator's weed prevention plans must include measures to prevent the spread of weed seeds from any vehicle or equipment. Additionally, during reclamation activities, early succession plants would be used for revegetation to provide a quick cover before noxious weeds can take root.

Wildlife surveys would be conducted prior to the approval of APDs. Qualified wildlife biologists and botanists would conduct the surveys and results would be reported to MFWP (animals) and the Montana Natural Heritage Program (MNHP) (plants) for consultation regarding avoidance and/or other wildlife and plant protective measures.

Camouflage of all wellheads in Class II Visual Resource Management Areas would be required to preserve the view shed. Camouflage would consist of paint chosen to blend in with the background and placement of wellheads to reduce visual obstructions.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Alternative E would provide management options to facilitate CBNG exploration and development, while sustaining resource and social values and existing land uses.

Exploration and development of CBNG resources on BLM-administered minerals are allowed subject to agency decisions, lease stipulations, permit requirements and surface owner agreements. Operators would be required to submit a project POD outlining the proposed development of an area when requesting CBNG well densities greater than 1 well per 640 acres. The project POD would be developed in consultation with the affected Tribes, affected surface owner(s) and other involved permitting agencies.

A step-by-step guideline for preparation of the project POD developed by BLM is available online at http://www.mt.blm.gov/mcfo/cbm/GuidanceMan/index.html (CBNG APD and Project POD Guidance Manual, May 28, 2003f). The project POD would be submitted in draft form so that it can be reviewed and any changes made prior to allowing surface disturbing activities. At a minimum, the project POD would have to contain the following:

- A cover letter naming the project area and requesting approval
- An APD (form 3160-3) for each federal well in the project area
- A list of all other permitting agencies involved in the project and the name for a point-of-contact for each office
- A list of all existing wells in the project area, including monitoring wells
- Maps submitted in paper or digital format (electronic map with any digital geographic information system (GIS) coverages used to create the map), showing proposed roads, compressor stations, pipelines, powerlines, CBNG well locations, all existing wells, current and proposed monitoring wells, surface ownership, mineral ownership, surface features and existing structures
- Master drilling information as required by Onshore Order No. 1 (for BLM-administered lands)
- Master surface use information as required by Onshore Order No. 1 (for BLM-administered lands)
- A Reclamation Plan for surface disturbance
- A wildlife monitoring plan demonstrating how the project will meet the needs of the BLM WMPP for BLM-administered lands (See Wildlife Appendix for a complete copy of the WMPP)
- A Water Management Plan for the project area
- Certification of surface use agreements or surface owner protection bond, certification of water well mitigation agreements (or notice that the Surface Owner Damage and Disruption Compensation Act applies and surface owner agreements are pending settlement or court action). (See Management common section for detailed explanation of agreements)
- A list of all potentially affected surface owners within the project area
- A cultural resource plan addressing identification strategies commensurate with the level of the proposed development (for BLM-administered lands). This may include a cultural resource location and significance model for identifying areas of critical concern.
- BLM would also require compliance with Onshore Oil and Gas Order Number 7 for Disposal of Produced Waters.

Alternative E combines water management options so that there would be no unnecessary or undue degradation as defined by the MDEQ of water quality allowed in any watershed. The preferred water management option of water produced with CBNG is for beneficial use. Other produced water management options include, but are not limited to, injection, treatment, impoundment and discharge. The operator must obtain 401 Certification from the MDEQ if the disposal action needs BLM approval. A Water Management Plan for Exploration would be required for exploratory wells and for each project POD. The Water Management Plan for Exploration would be required for CBNG exploration wells drilled under statewide spacing rules. At a minimum, the Water Management Plan would be part of an Application for Permit to Drill and certification that a water well or spring mitigation agreement with the owner has been ratified for any water well/spring within 1 mile; identify any proposed uses of the water (beneficial if possible); and a map showing all wells within 1 mile of the proposed exploratory CBNG well.

Water Management Plans developed as part of a project POD could include the following additional requirements:

- A cover letter identifying the project POD for which the Water Management Plan has been developed and the watershed(s) affected by the project
- A 7.5 minute topographical map indicating the location(s) of any proposed storage ponds and/or discharge points
- Water quality data for the produced water
- Anticipated rate of water production per well and the calculated amount of annual water production for the field
- Proposed beneficial uses of the produced water addressed in surface owner agreements
- Operator's approach to ensure no undue degradation of the surface water quality within the designated watershed(s)
- A copy of any MPDES discharge permit(s) issued by the MDEQ, if required; or a copy of the letter of compliance for MDEQ's General Discharge Permit; or UIC permit issued by the MBOGC or disposal permit issued by the EPA
- A water monitoring plan for the area that meets the requirements of MBOGC Rules and the Controlled Groundwater Area as outlined in the Monitoring Appendix

- A statement indicating whether a 401 Certification is required and if so, a copy of the certificate
- A copy of the most current soil map available for the project area
- Site-specific stratigraphy for any infiltration basin location that is proposed

Produced water management plans and permits would be approved by BLM or the appropriate agency in consultation with affected surface owners. Surface storage of produced waters would also require an MPDES permit issued by MDEQ. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts on soil, water, vegetation and channel stability. There would be no discharge of produced water (treated or untreated) into the watershed unless the operator has an approved MPDES permit and can demonstrate in the Water Management Plan how discharge could occur in accordance with water quality laws without damaging the watershed.

Shallow coal seams would have vertical wells installed while directional wells may be drilled to the deeper coal seams. Directionally drilled wells would be drilled from the same well pad as the vertical wells, unless the operator can demonstrate why directional drilling is not needed or feasible.

Development of coal seams would be done either one coal seam at a time or multiple coal seams at the same time. Production of CBNG would be from one coal seam per well or multiple coal seams per well. During production of CBNG from multiple coal seams from multiple wells, the wells would be collected on the same well pad. Well spacing rules would set a limit of one well per coal seam per designated spacing unit.

With regards to air quality, the objectives of this alternative are the same as for Alternative B (the number of wells connected to each compressor would be maximized and natural gas-fired engines for compressors and generators would be required), except in areas with sensitive resources, including people, where noise is an issue. In those areas, the decibel level would be required to be no greater than 50 decibels measured at a distance of 1/4 mile from the compressor. This may require the installation of an electrical booster at these locations. Operators of federal leases would be required to post and enforce speed limits to reduce fugitive dust emissions.

Transportation corridors would not be required; however, proposed roads, pipeline routes and utility line routes would be located to follow existing routes or areas of previous surface disturbance when possible. The operator would also address in the project POD how the surface owner was consulted for input into the location of roads, pipelines and utility line routes.

Powerlines are also a project POD consideration. The operator would demonstrate in the project POD how the proposal for power distribution would mitigate or minimize impacts on affected wildlife. For example, on BLM-administered lands the operator may be required to bury a portion of the powerlines near sage-grouse habitat to safely eliminate use by raptors and any aboveground lines be designed following raptor-safe specifications.

When wells are abandoned, the associated oil and gas roads would remain open or be closed at the surface owner's discretion. If the roads were requested to be closed they would be rehabilitated. This includes leaving BLM-administered surface roads open if access is desirable.

There would be no buffer zone for CBNG production around active coal mines (MSO-IM-2000-053).

The BLM would require federal lease operators to protect Crow and Northern Cheyenne groundwater and CBNG from loss or degradation.

Mitigation measures that would be applied to protect Northern Cheyenne Tribal resources are described in the Northern Cheyenne Mitigation Appendix.

In addition to the requirements outlined in the project POD and in the Water Management Plan, the following general environmental mitigation measures would be implemented to further reduce potential impacts:

- The air permitting process would include analyses of equipment emissions and associated ambient impacts. Emission sources that may violate ambient standards will not be issued a permit.
- Road placement would be limited to track boundaries where practical to reduce impacts on residential and agricultural lands.
- Displaced farmland, whether in crop production or not, will be reclaimed to original soil productivity through adoption of standard reclamation procedures.
- Operators will be required to comply with agency imposed conditions during times of high fire danger. Such conditions may include restrictions on types of activities allowed, hours of operation and requirements for maintaining certain fire suppression equipment at the work site. Operators must maintain a current fire suppression plan.
- During reclamation activities, early succession plants will be used for revegetation to provide a quick cover before noxious weeds can take root.

Operators would be required to include plans to prevent the spread of noxious weeds as part of their development plans. The noxious weed prevention plans must include measures to prevent the spread of weed seeds from any vehicles and equipment from or prior to mobilizing it to the project area.

- Operator reclamation plans would be developed in consultation with the surface owner. Reclaimed areas reseeded with native species would be required to be reseeded with a certified weed-free seed mix determined by the surface owner and would usually require at least two growing seasons to ensure a self-sustaining stand of seeded species.
- Camouflage of all wellheads in federal surface Class II Visual Resource Management Areas will be required to preserve the viewshed. Camouflage will consist of paint chosen to blend in with the background and placement of wellheads to reduce visual intrusions.
- Wildlife surveys on state lands to identify special status species will be conducted on potential habitat near drilling and production sites prior to the approval of federal APDs. Qualified wildlife biologists would conduct surveys and results will be reported to MFWP for consultation regarding avoidance and/or other wildlife protective measures.
- On BLM-administered lands impacts to wildlife will be monitored and addressed in the WMPP in addition to the mitigating measures for wildlife that are part of the standard APD review and approval process. Impacts to wildlife, including those species on public lands and on land adjacent to the reservations, would be monitored and addressed in accordance with the WMPP (see wildlife appendix).
- The affected Tribes would be invited to participate in the "steering group" that would evaluate information gathered during the inventory and monitoring phases of the Wildlife Monitoring and Protection Plan.
- The results of the Wildlife Monitoring and Protection Plan may be used to adjust conditions of approval on federal APDs. This includes measures needed to protect public lands and reservation wildlife from the impacts of CBNG development.

The following special survey activities would be conducted for the Gray Wolf, Canada Lynx and Grizzly Bear on BLM-administered lands as needed:

- Gray Wolf—Prior to APD approval, surveys would be conducted specifically for this animal, occupied dens, or scat. The corridor would be surveyed in the spring, before construction, by a wildlife biologist for scat. If scat is found, the site would be surrounded by a buffer zone recommended through consultation with a U.S. Fish & Wildlife Service (FWS) biologist. If wolves or other wolf indicators are found, FWS would be consulted and proper protocols followed.
- Canada Lynx—Any construction areas or drilling pads located in high elevation, old growth forested areas, especially areas with populations of hares or rabbits, would be surveyed prior to APD approval for scat and individual lynx following established protocols. If found, the site would be avoided and surrounded by a buffer zone recommended by FWS biologists.
- Grizzly Bear—Garbage and other human refuse would be removed from drilling and construction sites on a daily basis in potential bear habitat to avoid attracting bears. Surveys for scat and other sign of grizzly bears in remote areas would be conducted prior to APD approval. If found, protocol would be established after consultation with FWS biologists.

In addition, the following measures as prescribed in the FWS Biological Opinion will be implemented on BLM-administered lands:

Bald Eagles

- If a dead or injured bald eagle is located during construction or operation, the FWS Montana Field Office (406- 449-5225), or the Billings Suboffice (406-247-7367) and the Service's Law Enforcement Office (406-247-7355) will be notified within 24 hours of the next working day.
- Implementation of the Wildlife Monitoring and Protection Plan (Wildlife Appendix) of the Powder River and Billings Resource Management Plans.
- Power lines would be built to standards identified by the Avian Power Line Interaction Committee (1996) and additional standards as outlined in the Wildlife Monitoring and Protection Plan, to minimize electrocution potential.
- Surveys for active raptor nests and winter roost sites would be conducted prior to APD approval within a 0.5-mile width for bald eagles and bald eagle nests and within a 1-mile width for roosts. If the proposed CBNG site is found to be within a nesting or winter foraging area, CBNG work

will be halted until the nest is no longer active or until winter has passed and the foraging eagles have migrated.

- BLM leasing stipulations pertaining to bald eagles apply and will be implemented. This includes No Surface Occupancy (NSO) within 0.5 mile of nests active in the last 7 years and 0.5 mile of roost sites.
- Raptor inventories will be conducted over the entire CBNG project area every 5 years by BLM and MFWP.
- Nest productivity monitoring would be conducted by the BLM or a BLM approved biologist in areas with one or more well locations per section) and within 1 mile of the project area. Active nests located within 1 mile of project-related disturbance areas will be monitored between March 1 and mid-July to determine nesting success (i.e., number of nestlings or fledglings per nest).
- A seasonal minimum disturbance-free buffer zone of 0.5 mile would be established for all bald eagle nest sites (February 15 to August 15). These spatial and timing restrictions may be adjusted based on site-specific criteria after written approval from the FWS.
- Signing, speed limits, or speed bumps would be placed on all project access roads to reduce mortality caused by vehicle traffic.

Mountain Plover

- The FWS shall provide operators and the BLM with educational material illustrating and describing the mountain plover, its habitat needs, life history, threats and gas development activities that may lead to incidental take of eggs, chicks, or adults. These materials will be provided with the requirement that they will be posted in common areas, circulated in a memorandum and discussed among all employees and service providers.
- If a dead or injured mountain plover is located during construction or operation, the FWS Montana Field Office (406- 449-5225), or the Billings Suboffice (406-247-7367) and the Service's Law Enforcement Office (406-247-7355) will be notified within 24 hours of the next working day.
- The BLM, FWS and MFWP will estimate potential mountain plover habitat across the CBNG area using a predictive habitat model. During the next 5 years, information will be refined by field validation using the most current FWS mountain plover survey guidelines (FWS 2002c, Wildlife Appendix, Biological Assessment) to determine the presence or absence of potentially suitable mountain plover habitat. In areas of suitable mountain plover habitat, surveys will be conducted by the BLM or a BLM-approved biologist using the FWS protocol at a specific project area, plus a 0.5 mile buffer. Efforts will be made to identify mountain plover nesting areas that are not subject to CBNG development to be used as reference sites. Comparisons will be made of the trends in mountain plover nesting occupancy between these reference areas and areas experiencing CBNG development.
- Surveys for nesting mountain plovers will be conducted by appropriately trained personnel if ground-disturbing activities are anticipated to occur between April 10 and July 10. A disturbance-free buffer zone of 1/4 mile will be established around all mountain plover nesting locations between April 1 and July 31.
- No ground-disturbing activities shall occur in suitable nesting habitat prior to surveys conducted in compliance with the FWS Mountain Plover Survey Guidelines (FWS 2002c or more recent version, Wildlife Appendix, Biological Assessment), regardless of the timing of the disturbance. If occupied mountain plover nesting habitat is located, the BLM shall reinitiate consultation with the Service on any project-related activities for such habitat. The amount and nature of ground-disturbing activity shall be limited within identified nesting areas in a manner to avoid the abandonment of these areas.

Because of the potential for CBNG development to uncover Tribal culturally significant sites, the BLM would provide the tribes a copy of their annual cultural resources report, which would summarize CBNG-related cultural resource activities.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative, development of CBNG on federal leases in the Billings and Powder River RMP areas would be done in a phased manner through restrictions imposed by BLM. BLM would limit the number of federal APDs approved each year cumulatively (both state and federal APDs combined) and in each fourth order watershed. BLM would also limit the percentage of disturbance on BLM-administered surface or on private surface overlying

federal minerals within each identified crucial habitat area. Finally, BLM would place a limit on the volume of untreated water discharged to surface waters from federal CBNG wells within each fourth order watershed. The fourth order watershed level was adopted for this alternative because it provides a geographic perspective consistent with the analysis completed for the Statewide Document and is appropriate for the FSEIS analysis.

The cumulative limit placed on federal APDs would be based on 5 percent (910 wells) of the total number of state, private and federal wells (18,225 wells) predicted to be drilled in the Planning Area. Alternative F uses the high range as identified in the RFD scenario from the Statewide Document. This means if the total (private, state and federal) number of APDs issued at any time during a calendar year exceeded 910, then BLM would not issue any additional APDs that year (if the 910 limit were reached, APDs could still be submitted for review and BLM would process them up to the point before approval). The 5 percent limit was chosen to level the pace of development over a 20-year period and to apply a numerical limit to federal APD approvals.

BLM would also limit its approval of APDs each year within each fourth order watershed. This limit would be based on the total number of wells (state, private and federal) predicted for each watershed times the predicted rate of development as identified in the 2003 document (see Minerals Appendix, Figure Min-4). Therefore, cumulative APDs per year, per watershed would not exceed that percentage. If this percentage were to reduce the number of wells to below 50 wells per watershed, the limit would be suspended and 50 wells per watershed would be considered the upper limit for the watershed that year to allow the opportunity to develop an economically viable project.

BLM would also limit the amount of disturbed crucial habitat on BLM-administered surface or private surface overlying federal minerals. BLM would allow no more than 20 percent of any crucial habitat (e.g., crucial brood rearing/breeding/ wintering habitat) area to be directly impacted over a 20-year period. This would include removal of sagebrush resulting from the proposed project activities and other unrelated (non-CBNG) projects resulting in habitat removal (cumulative 20 percent). In addition, a corridor extending 200 meters on either side of travel routes with 12 or more vehicle uses per day would also be considered habitat directly impacted.

In crucial sage-grouse habitat (Map 3-18), development would be allowed under the following conditions:

Sage-grouse would not be displaced from crucial habitat. Displacement of sage-grouse may occur on a small scale around an individual well site. Populations in the crucial habitat would be compared to sage-grouse populations in predetermined areas outside of the CBNG development (baseline areas). Population trends within the CBNG development areas should be comparable to the baseline areas.

The baseline areas would be identified, inventoried and monitored. These areas would provide a baseline or background dataset for comparison to the sage-grouse habitat within the CBNG development area. Criteria for selection of the baseline areas, inventory methods and comparison methods are discussed in the Wildlife Appendix. The baseline areas would encompass areas of similar habitat types and contain active strutting grounds (leks). To account for variations in environmental stressors such as extreme winters, fire and West Nile virus (WNV), a minimum of three discrete and geographically separate areas would be used to establish the sage-grouse population baseline.

BLM recognizes that maintaining current populations within crucial sage-grouse habitat depends on many factors, including fire, agricultural practices and other land uses. These factors would be considered when evaluating monitoring data and determining whether or not the objectives of this alternative are met. The Wildlife Appendix provides a discussion of monitoring data that would be collected, how those data would be evaluated and the method for comparing populations within the CBNG development areas with the baseline areas.

The crucial habitat areas shown on Map 3-18 are likely to change as more information becomes available and other crucial lifecycle habitat (e.g., nesting or brood-rearing) is identified. These habitat areas are also likely to change due to wildfire and changes in land use, such as agriculture.

BLM and CBNG operators would evaluate alternative development schemes to maximize recovery of the gas resource while meeting the above condition. Alternative development schemes could involve dewatering centers with widely spaced gas recovery wells, siting compressors outside the habitat areas and horizontal drilling. In addition, mitigation measures could be used to reduce direct impacts on sage-grouse.

If the above conditions were met and development approved, retention of a sustainable sage-grouse population would be verified by applying the monitoring and data evaluation standards in the Wildlife Monitoring Appendix. If monitoring indicated sustainable sage-grouse populations were not being maintained, then development plans would be modified

or curtailed such that sustainable sage-grouse populations were maintained.

The combined numerical limits for cumulative and watershed development, coupled with the disturbed habitat limit, would necessitate a varied geographical development pattern across the Planning Area. It is anticipated only a few watersheds would be developed in the initial 3- to 5-year period (Upper Tongue, Lower Tongue, Middle Powder, Little Powder), while the remaining watersheds would most likely be developed in later years.

In addition to MPDES requirements, BLM would also establish a threshold for the volume of untreated water that could be discharged to surface waters from federal CBNG wells. This volume initially would be based on 10 percent of the 7Q10 flow, calculated cumulatively based on MPDES permits. This is a conservative limit based on the volume of water that could be discharged under an MPDES permit without exceeding non-degradation criteria.

The above criteria could be modified over time, as needed, based on monitoring data. If monitoring showed unacceptable impacts to surface water were occurring (i.e., approaching trigger values based on the applicable surface water standards), the amount allowed may be decreased; if monitoring showed noticeable impacts to surface water quality were not occurring, the amount allowed may be increased. This limit would apply to intermittent and ephemeral tributaries, as well as to main streams. Since intermittent and ephemeral streams have a 7Q10 of zero, no untreated discharge would be allowed from federal CBNG wells in these drainages. If state and private wells used the entire threshold amount, no discharge of untreated water produced by federal wells would be allowed into that drainage. All other federally produced water would have to be managed by other means (beneficial use; injection; treatment; placement in evaporation, infiltration, or storage pits or reservoirs; or other uses).

Treated discharges are defined as those waters that have been treated to the applicable, in-stream surface water standards at the end of a pipe. Mixing of treated and untreated waters would be allowed and would not be counted towards the cumulative limit, so long as the end of pipe water quality met applicable in-stream standards.

Within 5 miles of the Northern Cheyenne and Crow reservations, site-specific groundwater and air analyses would have to be included with the operator's POD submissions. This buffer is based upon concerns of the Northern Cheyenne Tribe and projected groundwater drawdowns forecast by modeling in connection with the Statewide 2003 EIS.

The operator's analyses would have to demonstrate whether Indian Trust Assets and air quality would be impacted from development of federal CBNG wells and must provide protection for these assets and resources. If the analyses do not show protection of Indian Trust Assets and air quality, BLM would not approve the APDs. Monitoring wells and air monitoring stations may have to be installed between the development area and the reservations to monitor impacts and demonstrate protection.

If monitoring indicates Indian Trust Assets and air quality are not being protected, mitigation measures for federal CBNG wells, including possible modifications to production, would be administered in consultation with the affected tribes. If CBNG development occurred on a reservation, this requirement may be modified in consultation with the tribes and other affected parties. The BLM restrictions would apply only to BLM-administered leases. Development on private and state leases would be managed by the Montana Board of Oil and Gas Conservation under state regulations.

BLM would continue to implement the concept of adaptive management by using data from studies, monitoring and inspections to guide approvals of federal lease operations. POD requirements, the use of state and federal permits, lease stipulations, surface owner agreements and other management actions, as described in Alternative E, would also be features of this alternative.

This alternative also requires each CBNG proposal with a density greater than one well per 640 acres include a water rationale section in the water management plan. The water rationale section must include a brief discussion of various water management options. At a minimum, these options must include discharge with and without treatment, beneficial use and injection and reinjection options. The discussion must include the advantages and disadvantages of implementation and operation, the effectiveness and the projected quantity of water that may be managed under each option. For example, the injection of produced water into the same aquifer or other usable shallow water aquifers has been analyzed to determine if it is feasible within the proposed project area or in another area chosen by the operator/lessee. The water rationale section would have to show why injection is not feasible, if this is the case. It would also have to show the percentage of produced water that could be injected, if feasible. Following this disclosure, the approach the developer proposes to use would be presented in detail.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, development of CBNG on federal leases in the Billings and Powder River RMP areas would be done following the same management actions as described under Alternative F; however, development would be limited to the low range of predicted wells (6,470) from the RFD. Therefore, the following would be applied under Alternative G:

- Annual cumulative limit (5 percent or 325 APDs/year)
- Fourth order watershed rate of development
- Wildlife habitat (20 percent over 20 years)
- Crucial sage-grouse habitat conditions
- Untreated produced water (10 percent of 7Q10) thresholds
- Reservation buffer distance (5 miles)
- Principles of adaptive management
- POD requirements
- State and federal permits and lease stipulations
- Discussion of a range of water management options

The low range of development, as described in the RFD, was developed following the same assumptions as the high range.

Alternative H—Preferred Alternative - Multiple Screens

Alternative H is BLM's preferred alternative for managing the development of CBNG resources on BLM-administered lands. Development in the Billings and Powder River RMP areas would be done in a phased manner through restrictions imposed by BLM.

The phased approach is intended to reduce the overall cumulative impacts to any resource by managing the pace and place as well as the density and intensity of federal CBNG development. In addition to the standard POD review, four evaluation screens for water, wildlife, Native American concerns and air would be applied. The screens would be used when reviewing proposals to identify impacts, develop mitigation measures and guide the decisionmaking process.

Figure 2-1 illustrates the process BLM would follow when reviewing PODs. This process involves reviewing the POD, making a permit decision, monitoring and assessing impacts and adjusting operations, implementing mitigation measures and reviewing thresholds. Thresholds would be adjusted when monitoring data justified a change (e.g. see "sage-grouse" in the Monitoring Appendix and the WMPP in the Wildlife Appendix.

Slower development rates (fewer wells approved and drilled each year) may extend the overall time required for extraction of the CBNG resources. If monitoring data indicate impacts to resources are being mitigated, the pace of development could increase.

The following would be applied under Alternative H.

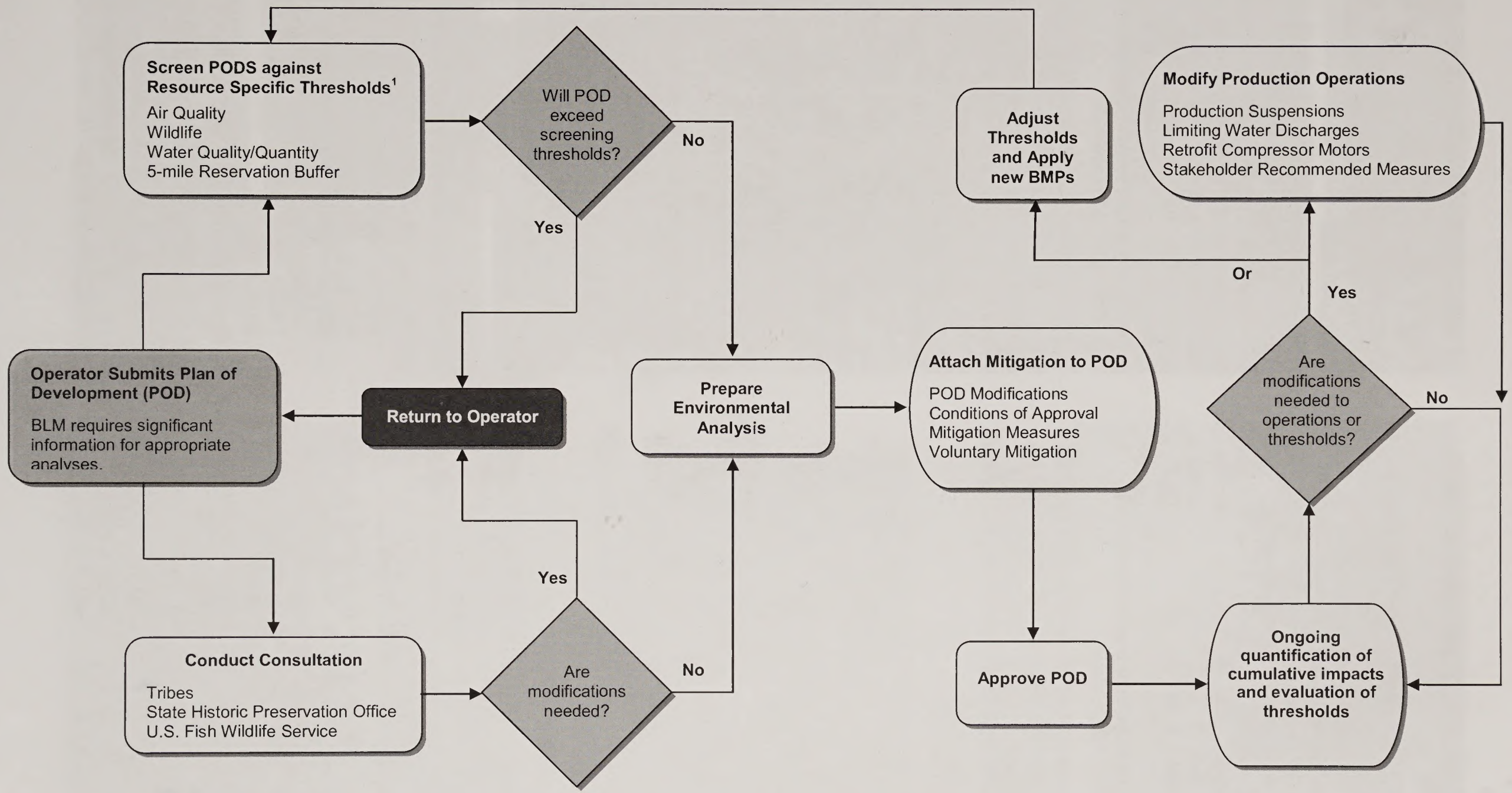
- Wildlife crucial habitat (maintain source population)
- Untreated produced water (10 percent of 7Q10 thresholds)
- Discussion of a range of water management options
- Reservation buffer distance (5 miles)
- Principles of adaptive management
- POD requirements
- State and federal permits and lease BMPs/conditions of approval (COAs)

Water Screen

BLM recognizes MDEQ has the lead role in managing water resources. BLM would coordinate all water monitoring efforts with MDEQ. While Onshore Order 7 reinforces BLM's approval authority for produced water disposal, it does not provide BLM with primacy for the management of water within the state of Montana. Therefore, BLM would apply the water quality screen in close coordination and under the lead of MDEQ. Close coordination would avoid duplication of effort and ensure each agency fulfilled its roles relative to resource management.

If proposed untreated discharges within a watershed are projected to exceed 10 percent of the 7Q10, BLM would coordinate with MDEQ to prepare an annual cumulative surface water monitoring report for that watershed. This report would incorporate The U.S. Geological Survey (USGS) and Discharge Monitoring Report (DMR) data collected within that watershed and evaluate the data against the applicable surface water quality standards. USGS collects data on a wide variety of parameters and DMRs are required for discharges to surface waters under MPDES permits. MDEQ determines the parameters reported in DMRs. If the results of analysis indicate CBNG discharges have the potential to cause exceedances of surface water quality standards, BLM would coordinate with MDEQ to

FIGURE 2-1 PREFERRED ALTERNATIVE – DECISION FLOW CHART



[1] Thresholds are displayed in the Monitoring Appendix.

develop appropriate mitigation measures to prevent exceedances.

In addition, if surface water monitoring indicated permitted levels of CBNG discharge would have a potential to cause water quality standards to be exceeded, no future untreated discharge of CBNG water would be allowed from federal wells unless the regional surface water monitoring stations above and below the proposed discharge were active. If CBNG discharges caused surface water quality standards or land health standards (i.e., excessive erosion) to be exceeded, even if discharges did not exceed the 10 percent of 7Q10 threshold, no additional CBNG discharges would be allowed from federal wells upstream of the exceedances.

Previously approved water management plans would be modified if monitoring indicated unacceptable impacts were occurring. Surface water monitoring requirements are detailed in the Monitoring Appendix.

Wildlife Screen

To meet the objectives of conserving wildlife habitat and the sagebrush steppe/mixed grass prairie complex in the FSEIS planning area, BLM would implement adaptive management based on available science and monitoring information. BLM would require BMP measures and alternative development schemes as permit COAs. See the WMPP in the Wildlife Appendix for the current list of specific COAs and BMPs. BLM would work with CBNG operators, surface owners, Native American tribes, FWS and MFWP to identify any additional protection measures necessary. On split estate lands, BLM recognizes that achieving the objectives of this alternative would require cooperation with surface owners.

All Wildlife Species

Data on potentially impacted wildlife habitat would be provided before, or in association with, the operator's POD. The POD would clearly identify how development activities would be designed to minimize impacts to wildlife habitat and maintain wildlife populations within the proposed POD area.

To help protect wildlife species that rely seasonally or year-long on crucial habitats (e.g., mule deer, pronghorns, sage-grouse, other sagebrush obligates), BLM would manage disturbance in such crucial habitats (e.g., crucial brood rearing, breeding and wintering habitat) where federal mineral ownership occurs. Crucial habitat for additional species, particularly Tier 1 species identified in the Montana Comprehensive Fish and Wildlife Strategy (2005d), may be identified and existing crucial habitats may be modified based on additional habitat monitoring surveys, wildlife population surveys and other information provided by industry, BLM and MFWP. With more information, the crucial areas may be modified or new areas identified. If crucial habitats are identified for species not presently addressed in this plan, additional environmental analysis and planning may be necessary.

Monitoring is described in the WMPP (including the defined methodology, responsibility and frequency). To use adaptive management and make meaningful determinations on the impact of development on wildlife habitat, up to 10 years of monitoring may be needed (see the Wildlife and Monitoring appendices). If science and monitoring indicate changes in development practices are warranted, these changes will be coordinated with MFWP.

BLM's management actions would be designed to affect the location and timing, as well as the density and intensity, of CBNG activities. Management may be modified if science and/or monitoring data indicate a change in wildlife species populations within crucial habitats on or adjacent to POD areas. For example, authorizations would not be given, or the pace of development would be restricted in crucial habitat areas that approach or exceed population change thresholds. Other examples of management actions BLM could impose include reducing the number of seasonal and/or yearlong authorized vehicle trips in existing areas of development, securing road access to limit vehicles not associated with development and modifying reclamation requirements for disturbed sites. If the population trend is downward, but has not yet reached the threshold, interim changes in management could occur. Similarly, if populations remain consistent with adjacent trend areas or increase, development may be less restricted, or the pace of development could be increased. Other factors such as wildfire, agricultural practices, recreational activities and disease would also be considered in determining the management for crucial habitat areas.

For mule deer and pronghorn habitat, the following thresholds would be used to initiate change:

- A 30 percent or more decline (based on MFWP adaptive harvest thresholds) in mule deer or pronghorn populations over a 3-year period relative to baseline and/or adjacent populations. Similarly, if populations remained consistent with adjacent trend areas or increase, development may be less restricted.
- Sage-grouse: See Sage-grouse Habitat Section.

These population thresholds, as well as population thresholds for other species, may be modified or established prior to POD approval based on relevant science, as well as suggestions from agency partners such as MFWP and FWS.

Sage-Grouse Habitat

The general approach described in the All Wildlife Species section would also apply to sage-grouse habitat. Additionally, BLM would manage sage-grouse habitat to meet the following objectives:

- Maintain the connectivity of habitats.
- Manage habitat to maintain healthy sage-grouse populations to serve as source populations.
- In crucial habitat areas, maintain sage-grouse habitat so that population trends follow the general magnitude of decline or increase on control leks. Changes in management of future development would occur if male attendance on leks within two miles of CBNG development declines by 25 percent over a 5-year increment. Changes may also be made if lesser declines occur in a period of less than 5 years, when compared with predetermined control leks. Management actions would include not authorizing or limiting the number of federal well sites, roads and infrastructure and not authorizing or restricting the timing of operations conducted on federal leases. Similarly, if populations remained comparable with the control leks or increase over a 5-year monitoring period, management of development may be modified to be less restrictive, or the pace of development may be increased.
    - These thresholds could be further refined before POD approval based on monitoring, relevant science, as well as suggestions from agency partners such as MFWP and FWS.
    - When development is proposed within crucial sage-grouse habitat, BLM would rely on science, professional judgment and monitoring data to determine the acceptable level of disturbance.

The objectives for crucial sage-grouse habitat would be to maintain sage-grouse populations on the northern end of the Powder River Basin, encourage genetic diversity, permit genetic exchange with other populations and ensure source populations would remain available for areas where sage-grouse may have been reduced or displaced due to CBNG development or other factors.

Sage-grouse habitat (leks, nesting, brood rearing and wintering) outside the crucial sage-grouse habitat boundaries would be managed to maintain connectivity by reducing habitat fragmentation. Management would focus on minimizing disturbance on seasonal habitats. BMPs would be used to minimize surface disturbance and these measures may be the basis for COAs. If management actions, COAs and/or BMPs were insufficient or overly restrictive, BLM would make the needed changes in order to maintain sage-grouse populations. Science and monitoring data would provide the basis for formulating alternative development scenarios and decisions would be coordinated with MFWP.

To meet the objectives for sage-grouse habitat management, PODs would have to demonstrate specific actions to conserve sage-grouse. Actual placement of wells would depend on the operator's ability to outline a strategy where effects to sage-grouse would be minimized and where sage-grouse would not be displaced from any of the crucial habitat as a result of these actions. The following examples illustrate such a situation:

- Within 1 mile of a lek, surface disturbance proposals would be sited to meet objectives for sage-grouse habitat management, including: avoid the loss of sagebrush, especially in linear routes (roads, flowlines and buried powerlines); avoid installation of perching structures; and keep noise disturbance levels at leks to less than 10 decibels above background noise on active leks. Special attention would be paid to proposals that would result in increased human presence, opportunities for increased predation, or loss of nesting and brood rearing habitat and function. This would not necessarily translate into no development within 1 mile of a lek, but would suggest special attention should be paid to features resulting in increased human presence, opportunities for increased predation and loss of nesting and brood rearing habitat and function.
- Proposals for storage ponds or produced water discharge into vegetated drainages in summer sage-grouse habitat would be designed to minimize the potential for outbreaks of WNV.
- The operator would be required to map and avoid seasonal habitats when proposing placement of infrastructure.

Crucial habitat areas have been identified in only a portion of the FSEIS planning area. BLM would continue to identify crucial habitat areas. New areas would be managed per this section. As research and monitoring continue, BLM and partners may develop new COAs and BMPs to supplement those already contained in the WMPP and other BLM publications.

Native American Concerns Screen

The Crow and Northern Cheyenne tribes consider groundwater and air to be critical resources for their tribal health and welfare. Tribal CBNG is an Indian Trust Asset. Groundwater is used on the reservations for stock watering and drinking water supplies. The tribes highly value air

resources, as well. In response to these concerns, BLM would require federal lease operators to protect groundwater, CBNG and air quality.

For proposed federal CBNG development within 5 miles of the Northern Cheyenne and Crow reservations, BLM, in consultation with the tribes, would require site-specific groundwater and air analyses (see Northern Cheyenne Mitigation Appendix for details). These analyses would be submitted as part of the operator's POD submissions. The operator's analyses must demonstrate development associated with the proposed POD would be protective of Indian Trust Assets (groundwater and CBNG) and air quality. BLM could disapprove additional CBNG APDs if available monitoring and air modeling of new proposals indicated effects that violate state or federal regulatory standards. In such cases BLM would first consider mitigation measures that would reduce impacts so that actions would comply with such standards. If implementation-level analyses indicate that unacceptable levels of impairment to these resources would occur and could not be mitigated, BLM would not approve the APDs. Unacceptable levels of impairment to the resources would be determined in consultation with the affected tribe(s) and the State of Montana, as appropriate. BLM may require operator(s) to install groundwater monitoring wells and air monitoring stations between the development area and the reservations to confirm the initial findings of the analyses. Modeling and monitoring groundwater would also provide critical data to determine if CBNG or resources were being affected.

As development proceeded, BLM would monitor the effects to air, water and other resources of concern to the Native American tribes. BLM would approve additional APDs only if available monitoring and evaluation of new proposals indicated effects would not exceed state or federal regulatory standards and were not substantially greater than those anticipated in the FSEIS (see Chapter 4 and Table MON-1 in the Monitoring Appendix.)

BLM would consult with affected tribes when operator's proposed actions were near American Indian traditional cultural properties, such as the Rosebud Battlefield, the Wolf Mountain Battlefield, Weatherman Draw and Sacrifice Cliffs. Consultation could result in mitigation of impacts to traditional cultural properties.

Air Quality Impact Screen

MDEQ has permitting authority over emission sources. EPA has permitting authority in the adjacent areas of Indian Country. BLM would conduct an annual review of available monitoring data collected in designated Class I areas (Northern Cheyenne Reservation) and federally mandated Class I areas (wilderness areas) within the Montana portion of the Powder River Basin.

In addition, MDEQ has agreed to complete an annual cumulative air quality impact model to track air quality impacts of CBNG development, including relevant CBNG development in Wyoming. The MDEQ requires all major sources (>25 tons/year) and all oxides of nitrogen (NO_x) emitting sources, in counties which make up the CBNG development area, to perform near-field air quality modeling. An evaluation of potential cumulative effects for each proposed air quality permit is also required (see description of Additional Air Quality Modeling Studies in Chapter 3 of the FSEIS)

If observed effects and modeled impacts completed for the annual review by MDEQ show state or federal regulatory standards or applicable thresholds for air quality related values would be exceeded, BLM would require additional mitigation measures on development. BLM could disapprove additional CBNG APDs if available monitoring and air modeling of new proposals indicated effects that violate state or federal regulatory standards. In such cases BLM would first consider mitigation measures that would reduce impacts so that actions would comply with such standards..

To minimize potential air impacts from CBNG operations, the number of wells connected to each compressor would be maximized and natural-gas-fired or electrical compressors or generators would be required. When compressors or generators were located close to noise sensitive areas (such as occupied residences or sage grouse strutting grounds), a maximum noise level of 50 decibels measured 0.25 miles from the compressor would be required, except at sage-grouse leks. At sage-grouse leks, no more than 10 decibels above background measured at the lek would be required.

To reduce dust, operators of federal leases would have to post and enforce speed limits for their employees and contractors. Operators would work with local government to use dust suppression techniques on roads.

Given the potential for the level of development to vary, BLM and MDEQ would perform additional visibility modeling to better assess the visibility impacts as development proceeds (e.g., when exploration programs help define the limits of development within the Montana portion of the Powder River Basin). The potential for project wells to impact visibility is due to emissions of sulfur dioxide and oxides of nitrogen from compressor engines. The total potential for emissions of oxides of nitrogen from

compressor engines is based on horsepower requirements, which for the high-end development scenario of 18,225 project wells drilled would be 297,680 horsepower. The visibility modeling would be performed when horsepower requirements for CBNG wells in the Montana portion of the PRB exceed 133,956. Current modeling results indicate 0 days of visibility impacts would occur on the Class I Northern Cheyenne area up to a horsepower level of 148,840. BLM has selected 90% of this value as the visibility screening threshold to ensure appropriate actions can be taken in time to mitigate visibility impacts, if needed. The Class I Northern Cheyenne area was selected as the "trigger Class I area" due to its proximity to the CBNG development, and the sensitivity to CBNG development of this Class I area when compared to other Class I areas in the region.

The visibility modeling effort would provide an updated prediction for future impacts and assumptions would be verified or modified to properly characterize actual conditions and technological changes. The conditions that may change or become more certain as development proceeds include:

- The total number and type of wells (type – single zone completion vs. multi-zone or commingled completions).
- The pace of development.
- BACT and the effect on compressor emission rates.
- Compressor locations.
- Compressor to well ratios.
- Limits of high development potential

If this subsequent modeling work indicates unacceptable impacts would occur at a future point in the PRB development, the modeling work would then include mitigation scenarios that would investigate mitigation measures. Mitigation efforts would focus on compressor motors and the extent of operating compressors because it appears that gas-fired compressor motors account for approximately 90% of the overall project emissions and visibility impacts.

Standard Operating Procedures and Best Management Practices

BMPs would be used, as appropriate, in CBNG development. BMP guidance is found in the Western Governors' Association April 2006 "Coal Bed Methane Best Management Practices," the "Surface Operating Standards for Oil and Gas Exploration and Development, Fourth Edition" (Gold Book) and BLM's national web site at http://www.blm.gov/bmp. The EPA has also developed BMPs for the prevention of methane emissions which are known as the Gas STAR BMPs. The Gas STAR BMP guidance is found at http://www.epa.gov/gasstar.

In addition to applying BMPs, CBNG operators would submit a project POD outlining the proposed development of an area when requesting CBNG well densities greater than one well per 640 acres. The project POD would be drafted in consultation with the affected tribes, affected surface owner(s) and permitting agencies.

POD Requirements

A complete project POD consists of the following:

- Master Drilling Plan
- Master Surface Use Plan
- Water Management Plan
- Cultural Resource Inventory Plan or completed inventory
- Wildlife Monitoring and Mitigation Plan
- Reclamation Plan for surface disturbance
- Digital project maps depicting all infrastructure installations necessary for the project, etc.
- Applications for Permits to Drill (form 3160-3) for each federal well
- List of all permitting agencies involved
- Certification of surface use and water well mitigation agreements
- A cover letter naming the project area and requesting approval
- A list of all known existing wells in the project area, including monitoring wells
- A list of all potentially affected surface owners within the project area
- Any additional information required by the rules of MBOGC

See Alternative E for a full description of each POD component.

Individual well APDs (those located at one well per 640 acres) would be accepted and processed without a project POD in accordance with requirements of Onshore Order 1. A project POD would be required before processing and approving APDs for multiple wells from an operator in the same geographic area. BLM would approve the project POD and individual APDs once they were technically and administratively complete and had met all BLM requirements.

On-site inspections would be conducted at the proposed federal well sites and associated

infrastructure before any ground-disturbing actions were approved.

PODs that include development within the crucial sage-grouse habitat areas must include information that clearly demonstrates how the proposal would not displace sage-grouse from this habitat. This information would be based on recent research and science, monitoring data and may also include alternative development schemes within these habitat areas.

Wells and Well Pads

CBNG well spacing rules are set by the MBOGC on state and private lands and on federal lands as specified in the Memorandum of Understanding between BLM and MBOGC; however, MBOGC has no authority on Indian lands. A wellpad may contain multiple wells (one well per coal seam), or a single well could open across multiple seams. Wells may be directionally or vertically drilled, depending on the surface location and desired bottomhole location.

Coal Mines

There would be no buffer zone excluding CBNG production around active coal mines (BLM-IM-2006-153, May 11, 2006). BLM advocates the extraction of oil and gas resource, including methane, before mining and promotes the development of multiple mineral resources.

Roads, Pipelines and Other Infrastructure

Corridors would be required for placement of roads, pipelines and utility lines in a common area of disturbance wherever possible. Proposed roads, pipeline routes and utility line routes would be located to follow existing routes, or areas of previous surface disturbance, or to minimize disturbance to important habitats, where possible. In the POD, the operator would also address how the surface owner, BLM and adjacent oil and gas operators and infrastructure companies were consulted for input into the location of roads, pipelines and utility line routes.

There would be minimal road construction. Before approving a road, the operator, landowner, BLM and adjacent landowners and gas leaseholders would coordinate long-term planning for roads in the area. Discussions with affected parties would take place to help meet the transportation corridor requirement to minimize new roads.

Low-voltage (440-v) distribution powerlines would be buried. The authorized officer (AO) could approve proposed high-voltage, acrial powerlines by application. The AO would approve above-ground, low-voltage distribution powerlines only if the operator could demonstrate it would not be feasible or would be impractical to bury them (technically impossible, etc.). All aerial powerlines would be constructed according to the Avian Power Line Interaction Committee (APLIC) Guidelines, 1996.

Produced Water Management

A water management plan (WMP) would be required for exploratory wells and for each project POD. The WMP would be submitted with the APD(s). The WMP must comply with all federal, state and local laws and regulations, including the Clean Water Act, the Montana Water Quality Act and Onshore Order 7. The WMP must be prepared in accordance with the Miles City CBNG POD Guidebook. The basic elements of a WMP would include the following:

- Water quality data for the produced water
- A copy of any needed discharge or injection permit(s) or applications for such permits
- Applications for unlined impoundments proposed as part of the Water Management Plan that must demonstrate that the infiltration of water would not degrade the quality of surface or subsurface waters in the area (Onshore Oil and Gas Order No. 7, Section III.D.2.)
- A water balance projection showing the anticipated rate of water production over time, the proposed water management practices (preferably beneficial uses) and the amount of water that would be managed by each of the practices over time

The operator would have to list the water management options available and provide a brief rationale for using or not using each method. At a minimum, injection; treatment; surface discharge; the use of infiltration, storage, or evaporation pits or reservoirs; and beneficial uses, such as wildlife and livestock watering, dust control and managed irrigation, would have to be addressed.

Wildlife Monitoring Program and Mitigation Measures

On BLM-administered lands, impacts to wildlife would be monitored and addressed following procedures in the WMPP, in addition to applying mitigating measures that are part of the standard APD review and approval process. Impacts to wildlife, including those species on public lands and adjacent to reservations, would be monitored and addressed in accordance with the WMPP (see Wildlife Appendix).

Bald Eagles

- If a dead or injured bald eagle were located during construction or operation, the FWS Montana Field Office (406-449-5225) or the Billings Suboffice (406-247-7366) and the Service's Law Enforcement Office (406-247-7355) would be notified within 24 hours of the next working day.
- The WMPP (Wildlife Appendix) of the Powder River and Billings Resource Management Plans would be implemented.
- Surveys for active bald eagle nests and winter roost sites would be conducted before APD approval. Surveys would be conducted within a 0.5-mile radius of proposed development for bald eagles and their nests and within a 1-mile radius for roosts. If the proposed CBNG site were found to be within a nesting or winter foraging area, CBNG related activities would be halted until the nest was no longer activc or until winter had passed and the foraging eagles had migrated.
- The BLM leasing stipulations pertaining to bald eagles would apply and would be implemented. This would include NSO within 0.5 mile of nests active within the past 7 years and 0.5 mile of roost sites.
- Raptor inventories including bald eagles would be conducted over the entire CBNG project area every 5 years by BLM and MFWP.
- Nest productivity would be conducted by BLM or a BLM-approved biologist in areas with one or more well locations per section and within 1 mile of the project area. Active nests within 1 mile of project-related disturbance areas would be monitored between March 1 and mid-July to determine nesting success (i.e., number of nestlings or fledglings per nest).
- A seasonal, minimum-disturbance-free buffer zone of 0.5 mile would be established for all bald eagle nest sites (February 15 to August 15). These spatial and timing restrictions may be adjusted based on site-specific criteria with written approval from FWS.
- Signing, speed limits, or speed bumps would be placed on all project access roads to reduce mortality caused by vehicle traffic.

Mountain Plover

Listing the mountain plover under the Endangered Species Act (ESA) is not warranted at this time. BLM would continue monitoring to help prevent the bird from being listed in the future.

- FWS would provide operators and BLM with educational material illustrating and describing the mountain plover, its habitat needs, life history, threats and gas development activities that may lead to the incidental taking of eggs, chicks, or adults. These materials would be provided with the requirement they be posted in common areas, circulated in a memorandum and discussed among employees and service providers.
- If a dead or injured mountain plover were located during construction or operation, the FWS Montana Field Office (406- 449-5225) or the Billings Suboffice (406-247-7367) and the Service's Law Enforcement Office (406-247- 7355) would be notified within 24 hours of the next working day.
- BLM will determine the acreage of occupied black-tailed and white-tailed prairie dog habitat within suitable mountain plover habitat on federally managed surface and mineral estate lands. Further, a reasonable effort should be made to estimate the actual impacts, including habitat loss, CBNG development will have on occupied black-tailed and white-tailed prairie dog acres within suitable mountain plover habitat over the entire project area. The BLM, FWS and cooperators will devclop a survey protocol that may include prioritization of subsets of the project area to be analyzed.
- In areas of suitable mountain plover habitat, surveys would be conducted by BLM or by a BLM-approved biologist using the FWS protocol at a specific project area, plus a 0.5 mile buffer. Efforts would be made to identify mountain plover nesting areas not subject to CBNG development to be used as reference sites. Comparisons would be made of the trends in mountain plover nesting occupancy between these reference areas and areas experiencing CBNG development.
- Surveys for nesting mountain plovers would be conducted by appropriately trained personnel if ground-disturbing activities were anticipated to occur between April 10 and July 10. A disturbance-free buffer zone

of 0.25-mile would be established around all mountain plover nesting locations between April 1 and July 31.

- No ground-disturbing activities would occur in suitable nesting habitat before surveys were conducted in compliance with FWS's Mountain Plover Survey Guidelines (FWS 2002c or more recent version, Wildlife Appendix and Biological Assessment), regardless of the timing of the disturbance. The amount and nature of ground-disturbing activity must be limited within identified mountain plover nesting areas in a manner to avoid the abandonment of these areas.

Sage-grouse

- BLM and cooperators, including MFWP will conduct sage-grouse lek inventories over the CBNG project area with high potential for development every five years. Surveys of different areas may occur during different years, with the high potential CBNG project areas surveyed at least every five years. Inventories and protocol will be consistent with the *Montana Sage Grouse Conservation Plan*, coordinated by the BLM and MFWP. In areas of development, aerial or ground inventories will be conducted annually on affected sections, two mile buffers and selected undeveloped reference areas. Surveys may be conducted aerially or on the ground, as deemed appropriate by the BLM and MFWP. Operator may provide financial assistance.
- Reference leks are leks located in similar habitat and within close proximity to areas currently being developed. These "reference leks" will be identified by BLM and MFWP.
- Aerial or ground surveys will be used for determining lek locations. BLM, MFWP or BLM-approved Operator-financed biologist will monitor sage-grouse lek attendance within two miles of areas of development, such that all leks on these areas are surveyed annually. Data collected during these surveys will be recorded on BLM and MFWP approved data sheets and entered into the approved database. The number of males/lek in areas of development will be compared to reference leks.
- Sage-grouse winter use surveys of suitable winter habitat within two miles of a project area will be coordinated by the BLM and conducted by the BLM and/or MFWP during November through February as deemed appropriate by these agencies. Results will be provided in interim and/or annual reports. Historical information of winter sage-grouse locations will be useful in focusing efforts in areas suspected of providing winter habitat.

Big Game

Elk, mule deer, white-tailed deer and pronghorn are the common big game species that occur within parts or all of the CBNG planning area. BLM and/or MFWP will collect annual big game seasonal habitat use data and make it available to operators, Tribes and landowners. Big game use of seasonal habitats is highly dependent upon a combination of environmental factors including terrain, forage quality and snow depth. Therefore, it is difficult to attribute changes in habitat use to a single factor. Comparisons in trends between big game seasonal habitat reference areas and seasonal habitats associated with CBNG development may provide some insight into the response of big game to CBNG development.

Comparison of Alternatives

The differences between alternatives by development theme are shown in Table 2-2. The variations for development by theme are compared for the eight alternatives carried forward for detailed analysis.

A range of potential issues affecting development has been analyzed in the context of the themes described for each alternative. The comparison focuses on the various techniques typically used to develop CBNG fields. The variations between alternatives reflect the different potential drilling technologies, water disposal methods, transportation corridor construction, compressor engines, socioeconomic issues, etc. These alternatives represent the majority of development techniques commonly used with CBNG operations. There are general and specific assumptions as to percentages of use per theme within each alternative. These assumptions are presented in Chapter 4, Environmental Consequences.

Table 2-3 shows a comparison summary of the impacts expected under each alternative.

TABLE 2-2
ALTERNATIVE MANAGEMENT FOR CBNG

Issue Topic	Management Action	Alternative A—No Action (Existing CBNG Management)	Alternative B—CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBNG Development	Alternative D—Encourage CBNG Exploration and Development While Maintaining Existing Land Uses	Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses	Alternative F (High Range) & Alternative G (Low Range)—Phased Development Multiple Screens	Alternative H—Preferred Alternative - Multiple Screens
Air	Maximize the number of wells connected to each compressor	No	Yes	No	Yes	Yes	Yes	Yes
	Type of fuel to power compressors	Diesel, electric, or gas-fired	Gas-fired	Diesel, electric, or gas-fired	Gas-fired with electric boosters	Gas-fired or electric boosters	Gas-fired or electric boosters	Gas-fired or electric boosters
	Noise suppression required	No	No	No	No	Yes	Yes	Yes
	Implementation of a speed limit on CBNG roads on BLM	No	Yes	No	Yes	Yes	Yes	Yes
	Air permit analysis	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Air screen	No	No	No	No	No	No	Yes
Bonding	43 CFR 3104 - BLM to set amount based on several factors.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Section 9 SRHA	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coal Mines	Buffer zone (1 mile) around active coal mines	No	Yes	No	Yes	No	No	No
Coal Bed Natural Gas	APD to be filed and approved prior to drilling	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	CBNG exploration limits	Yes	No	No	No	No	No	No
	CBNG production limits	Yes	No	No	No	No	Yes, based on watershed level resource analysis	Yes, based on four screens

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Coal Bed Natural Gas (cont.)	Project POD required in consultation with tribes, surface owners and other agencies	No	No	No	No	Yes	Yes	Yes
	Directional drilling required	No	Yes	No	Yes	Yes, unless exempted	Yes, unless exempted	No
	Multiple coal seams developed per well bore required	No	Yes	No	Yes	No	No	No
	Simultaneous coal seam development required	No	Yes	No	Yes	No	No	No
	Wellhead camouflage required by BLM	No	No	No	Yes	Yes	Yes	Yes
Hydrology	Exploration water disposal	Untreated and stored, except for CX Ranch	Untreated and stored	Untreated surface discharge	Treated and conveyed	Exploration WMP required	Exploration WMP required	Exploration WMP required
	Production water disposal	CX Ranch only	Injection	Untreated surface discharge	Treated and conveyed	Various methods WMP required	Water screen (10% of 7Q10) WMP required	Water screen (10% of 7Q10) WMP required
	Site-specific WMP required	Yes	No	No	No	Yes	Yes	Yes
	Exploration/production water available for beneficial use	Yes	No	Yes	Yes	Yes	Yes	Yes
	Ponds (evaporation, infiltration, holding)	No	Lined holding only	Yes	Yes	Yes	Yes	Yes
	Water balance projection included in POD	No	No	No	No	Yes	Yes	Yes
	West Nile Virus management mitigation required	No	No	No	No	No	No	Yes

TABLE 2-2
ALTERNATIVE MANAGEMENT FOR CBNG

Issue Topic	Management Action	Alternative A—No Action (Existing CBNG Management)	Alternative B—CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBNG Development	Alternative D—Encourage CBNG Exploration and Development While Maintaining Existing Land Uses	Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses	Alternative F (High Range) & Alternative G (Low Range)—Phased Development Multiple Screens	Alternative H—Preferred Alternative - Multiple Screens
Realty	Corridors required	No	Yes	No	Yes	No, with surface owner consultation	Possibly, based on watershed level resource analysis and with surface owner consultation	Yes
	Powerline placement	Aboveground or buried	Buried	Aboveground or buried	Buried	Aboveground or buried	Aboveground or buried	Buried (low-voltage) high-voltage by application only
	Abandoned access roads	Agency/surface owner discretion	Agency/surface owner discretion	Agency/surface owner discretion	Agency/surface owner discretion	Agency/surface owner discretion	Agency/surface owner discretion	Agency/surface owner discretion
	High fire danger restrictions	No	Yes	No	Yes	Yes	Yes	Yes
	Road use enforcement on BLM (additional fences and gates to reduce public access and overuse, coupled with speed limits)	No	Yes	No	Yes	No	No	Yes
	Long-term stakeholder planning	No	No	No	No	No	No	Yes
Indian Trust and Native American Concerns	Buffer zone (2 miles) around reservations	No	Yes	No	Yes	No	No	No
	Monitoring wells required on BLM-administered minerals that abut reservations	No	No	No	No	May be required	May be required	May be required

TABLE 2-2
ALTERNATIVE MANAGEMENT FOR CBNG

Issue Topic	Management Action	Alternative A—No Action (Existing CBNG Management)	Alternative B—CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBNG Development	Alternative D—Encourage CBNG Exploration and Development While Maintaining Existing Land Uses	Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses	Alternative F (High Range) & Alternative G (Low Range)—Phased Development Multiple Screens	Alternative H—Preferred Alternative - Multiple Screens
Indian Trust and Native American Concerns (cont.)	Resource protection protocols	No	No	No	No	Yes	Yes	Yes
	Air quality mitigation measures	No	No	No	No	Yes	Yes	Yes, based on air screen
	Special cultural resources protection measures	No	No	No	No	Yes, Cultural Resource Plan required in POD	Yes, Cultural Resource Plan required in POD	Yes, Cultural Resource Plan required in POD
	Buffer zone (5-miles) with site specific groundwater and air analyses	No	No	No	No	No	Yes, consultation required if resource impacts predicted within reservation	Yes, consultation required if resource impacts predicted within reservation
	Air quality monitoring for reservations	No	No	No	No	Yes, depending on negotiated mitigation measures	Yes, depending on developments proximity to reservations	Yes, depending on developments proximity to reservation
Vegetation	Commercially harvest ROW trees on BLM	No	Yes	No	No	Agency or surface owner discretion	Agency or surface owner discretion	Agency or surface owner discretion
	Revegetate with early successional and late seral stage plants on BLM	Agency or surface owner discretion	Agency or surface owner discretion	Agency or surface owner discretion	Agency or surface owner discretion	Agency or surface owner discretion	Agency or surface owner discretion	Agency or surface owner discretion
	Noxious weed control by operator	Yes	Yes	No	Yes	Yes	Yes	Yes

TABLE 2-2
ALTERNATIVE MANAGEMENT FOR CBNG

Issue Topic	Management Action	Alternative A—No Action (Existing CBNG Management)	Alternative B—CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBNG Development	Alternative D—Encourage CBNG Exploration and Development While Maintaining Existing Land Uses	Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses	Alternative F (High Range) & Alternative G (Low Range)—Phased Development Multiple Screens	Alternative H—Preferred Alternative - Multiple Screens
Wildlife	Wildlife surveys required	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Gray wolf, Canada lynx and grizzly bear surveys	As needed	As needed	As needed	As needed	Yes	Yes	Yes
	20/20 Screen Sage-grouse crucial habitat screen	No	No	No	No	No	Yes	No
	Crucial Sage-grouse habitat – Demonstration that viable grouse populations will be maintained	No	No	No	No	No	Yes	Yes
	Sage-grouse habitat area objectives – Connectivity and source populations	No	No	No	No	No	Yes	Yes
	Manage disturbance in crucial wildlife habitats where federal mineral ownership occurs	No	No	No	No	No	No	Yes
	Change management if sage-grouse populations decline by more than 25 percent over 5-year increment	No	No	No	No	No	No	Yes
	Implement WMPP	No	No	No	No	Yes	Yes	Yes

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Number of wells predicted for analysis purposes:							
• Federal/State – up to 925 CBNG and 1,720 conventional wells. • Cumulative – up to 925 CBNG and 1,775 conventional wells.	• Federal/State – up to 18,275 CBNG and 1,720 Conventional wells. • Cumulative – up to 26,475 CBNG and 1,775 conventional wells.	• Federal/State – up to 18,275 CBNG and 1,720 conventional wells. • Cumulative – up to 26,475 CBNG and 1,775 conventional wells.	• Federal/State – up to 18,275 CBNG and 1,720 conventional wells. • Cumulative – up to 26,475 CBNG and 1,775 conventional wells.	• Federal/State – up to 18,275 CBNG and 1,720 conventional wells. • Cumulative – up to 26,475 CBNG and 1,775 conventional wells.	• Federal/State – up to 18,225 CBNG and 1,720 conventional wells. • Cumulative – up to 26,425 CBNG and 1,775 conventional wells.	• Federal/state – up to 6,470 CBNG and 1,720 conventional wells. • Cumulative – up to 14,670 CBNG and 1,775 conventional wells.	• Federal/state – up to 18,225 CBNG and 1,720 conventional wells. • Cumulative – up to 26,425 CBNG and 1,775 conventional wells.
Air Quality *Existing air quality throughout most of the analysis area is in attainment with all ambient air quality standards. However, three areas have been designated as federal nonattainment areas where the applicable standards have been violated in the past: Lame Deer (PM_{10}—moderate) and Laurel (SO_2—primary), Montana; and Sheridan, Wyoming (PM_{10}—moderate).*							
• Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations. • Maximum concentrations are expected to be below applicable state and National Ambient Air Quality Standards and PSD increments for near-field and far-field modeling.	• Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations. • Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.	• Impacts under Alternative C are expected to be comparable to those describe for Alternative B but somewhat increased in severity due to the lack of control over operators choose for compressor fuel, reduced limits on compressor hook ups and the lack of enforceable control measures.	• Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations. • Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.	• Impacts under Alternative E would consist of localized short-term increases in NO_x, SO_2 and PM_{10} concentrations. Most maximum concentrations would be expected to be below applicable state and NAAQS, as well as NAAQS PSD increments. • Alternative E would not result in increases in Acid Neutralizing Capacity above 10 percent for any Class I areas in the modeling domain. • Visibility impacts of 1.0 dv would occur in 7 to 10 PSD Class I areas and 6 to 12 PSD Class II Area.	• Impacts under Alternatives F would be comparable to those described for Alternative E, but would be lowered and leveled over time due to the 5% annual limit for APDs approved on BLM-administered land.	• Impacts under Alternative G would be lower than for Alternatives E or F due to fewer wells predicted to be drilled. This would result in a reduction of approximately 65% in the number of compressors that would be required. Fewer well pads and roads would also have to be constructed.	• Impacts under Alternatives H would be comparable to those described for Alternative E but would be lowered and leveled over time due to implementing the four screens for CBNG development.

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Air Quality (cont.)							
• Potential direct impact on visibility within one mandatory federal PSD Class I, one Class II Area and the Class II Crow Reservation. • Cumulative Impacts: - Potentially exceed the 24-hour PM_{10} NAAQS and PSD Class II increments south of Spring Creek Mine. - Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation.	• Potential direct visibility impacts within seven mandatory federal PSD Class I Areas and the Northern Cheyenne Reservation. Additional visibility impacts to seven federal PSD Class II areas including the Crow and Fort Belknap reservations and three Wilderness • Areas and one National Recreation Area and one National Monument. • Cumulative Impacts: -Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$ NAAQS south of Spring Creek Mine. Potentially exceed the PSD Class II increments for 24-hour PM_{10} south of Spring Creek Mine.	• Cumulative Impacts: - Same as Alternative B.	• Potential direct visibility impacts within one mandatory federal PSD Class I Areas. Additional visibility impacts to three PSD Class II areas including the Crow Reservation, one Wildemess Area and one National Recreation Area. • Cumulative Impacts: - Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$ NAAQS south of Spring Creek Mine. - Potentially exceed the PSD Class II increments for 24-hour PM_{10} south of Spring Creek Mine.	• Air quality modeling indicates visibility impacts of 1.0 dv would occur in 7 to 10 PSD Class I areas and 6 to 12 PSD Class II Area. The air quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies. • Cumulative Impacts: - Given the non-project emission sources located throughout the analysis region, there would be a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative E. However, none of the predicted impacts would exceed state or NAAQS.	• Cumulative Impacts: - Cumulative impacts under Alternative F would be the same as for Alternative E.	• Cumulative Impacts: - Cumulative impacts under Alternative G would be fewer than for Alternatives E or F due to fewer wells predicted to be drilled. This would result in fewer compressors, well pads and roads that would have to be constructed.	• Cumulative Impacts: - Cumulative impacts under Altematives H would be comparable to those described for Alternative E.

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Air Quality (cont.)							
- Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area. - Potential visibility impacts in 10 of 17 federal PSD Class I including the Crow and Fort Peck reservations. Additional visibility impacts to 7 of 13 PSD Class II sensitive areas including the Crow and Fort Belknap reservations.	- Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and at Washakie. - Potentially exceed PSD Class I increments for annual NO_2 on the Northern Cheyenne Reservation. - Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area and Florence Lake in the Class II Cloud Peck Wilderness Area. - Potential visibility impacts in all federal PSD Class I and II sensitive areas including the N. Cheyenne, Fort Peck, Fort Belknap and Crow reservations.		- Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and Washakie WSA. - Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area. - Potential visibility impacts in 14 of 17 federal PSD Class I and all Class II sensitive areas including the N. Cheyenne, Fort Peck, Fort Belknap and Crow reservations.			

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Cultural Resources *Approximately 73,600 cultural resource sites may occur above known coal resources within the CBNG emphasis area*							
• An estimated 17 cultural resource sites could be identified during foreseen CBNG activities. Of these only one or two would likely be eligible for the NRHP.	• The number of cultural resource sites identified would be practically the same for Alternatives B, C, D and E based on the level of development, associated area of disturbance and minor differences between the alternative realty management actions. An estimated 630 cultural resource sites would be identified, of these sites, 120 to 170 could be found eligible for the NRHP. The number of sites in Alternatives F through H reflect additional cultural resource sites located during surveys after April 2003.			• An estimated 893 to 1,080 cultural resource sites could be identified.	• An estimated 893 to 1,080 cultural resource sites could be identified. • Should no drilling occur within crucial sage-grouse habitat areas, the number of cultural resources sites that could be identified would be reduced by 12.8% from 942 to 779.	• Impacts would be similar to Alternative F with the exception that the number of cultural resource sites identified would be reduced by approximately 65% due to fewer federal APDs that would have to be issued. • An estimated 312 to 378 cultural resource sites could be identified, based on the reduced number of federal APDs predicted to be issued.	• An estimated 893 to 1,080 cultural resource sites could be identified.
• Cumulative Impacts: - An estimated 4,285 cultural sites would be identified. resulting in 430 to 612 sites likely eligible for the NRHP.	• Cumulative Impacts: - An estimated 5,135 cultural sites could be identified resulting in 515 to 735 sites that could be eligible for the NRHP.			• Cumulative Impacts: - An estimated 5,398 to 5,585 cultural sites could be identified.	• Cumulative Impacts: • An estimated 5,398 to 5,585 cultural sites could be identified. • If no drilling occurred within crucial sage-grouse habitat, the number of cultural resources sites that could be identified would be reduced from 5,447 to 5,284.	• Cumulative Impacts: - An estimated 4,817 to 4,883 cultural sites could be identified, based on the reduced number of federal APDs predicted to be issued.	• Cumulative Impacts: - An estimated 5,398 to 5,585 cultural sites could be identified.

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Cultural Resources (continued) *Approximately 73,600 cultural resource sites may occur above known coal resources within the CBNG emphasis area*							
- Identification of traditional cultural properties (TCPs) would increase with the development of CBNG.				• Identification of TCPs would increase with development of CBNG.	• Identification of TCPs would increase with development of CBNG.	• Potential for impacts to TCPs would be similar to those for Alternative F, but would be reduced by approximately 65%.	• Potential for impacts to TCPs could be similar to Alternatives B, C, D, E and F.
Environmental Justice *Executive Order 12898 requires the non-discriminatory treatment of minority and low-income populations for projects under the jurisdiction of a federal agency*							
• Few adverse impacts with the exception of the undetermined Wyoming discharge influence. • No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.	• No adverse human health impacts would be expected to fall disproportionately on minority or low-income populations from this alternative. • The influence of Wyoming's discharge on Montana's rivers would constitute a potential environmental justice issue if unresolved.	• Same as B except for adverse environmental effects would be expected from downstream water quality changes resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.	• No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.	• No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. • Impacts would be mitigated as described under the Environmental Justice section, Alternative A and by implementation of the Project POD requirements.	• No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues would be the same as for Alternative B • Project Plan and watershed-level analysis requirements would help mitigate potential impacts. • Project Plan consultation with Tribes and ongoing monitoring for developments within 5 miles of a reservation would help to protect Indian Trust Assets.	• Impacts would be lower than for other development alternatives due to fewer wells being developed. • No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues would be the same as for Alternative B. • Project Plan and watershed-level analysis requirements would help mitigate potential impacts.	• Impacts would be similar to Alternative F due to similar number of wells developed. With mitigation, no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B. • Project Plan, resource screens and watershed-level analysis requirements would help to mitigate potential impacts.

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Environmental Justice (continued) *Executive Order 12898 requires the non-discriminatory treatment of minority and low-income populations for projects under the jurisdiction of a federal agency*							
						• Project Plan consultation with tribes and ongoing monitoring for developments within 5 miles of a reservation would help to protect ITAs.	• Project Plan consultation with tribes and ongoing monitoring for developments within 5 miles of a reservation would help to protect Indian Trust Assets.
Geology and Minerals *Montana's mineral resources are intimately tied to the complex geologic framework of the state. Locatable minerals and conventional Oil and Gas resources are found throughout the Planning Area in various recoverable and non-recoverable amounts*							
• Federal: - Only minor loss of CBNG during testing operations.	• Federal: - Irretrievable commitment of CBNG resources from production, magnitude and complexity to reflect increase scale of development. - Potential mineral drainage between Federal mineral estates and state, private and tribal developments depending on site-specific conditions.	• Federal: - Same as Alternative B with the addition of increased water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone.	• Federal: - Same as Alternative B.	• Federal: - Same as Alternative B with the addition of increased water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone. - Protection of potential tribal CBNG from drainage because of resource protection protocols.	• Federal: - Irretrievable commitment of CBNG resources from production, rate of development would be managed by limit set on the number of federal APDs that would be approved per year, geographic development of CBNG resources managed through limits set on the number of APDs allowed for each fourth order watershed.	• Federal: - Irretrievable commitment of CBNG resources from production, rate of development would be 65% less than alternative F. - The potential for mineral drainage between federal mineral estates and other mineral owners would be 65% lower than for Alternative F due to the lower number of wells developed.	• Federal: - Irretrievable commitment of CBNG resources from production, magnitude and complexity would reflect increase scale of development - Potential mineral drainage between federal mineral estates and state, private and tribal developments depending on site-specific conditions.

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Geology and Minerals (cont.)							
	- The presence of shallow CBNG produetion could delay or interfere with certain types of seismic prospeeting for eonventional oil and gas reservoirs.				- Potential mineral drainage between federal mineral estates and state, private ,and tribal developments depending on site-specifie eonditions and increased potential for drainage of federal minerals due to eumulative limit on number of federal APDs allowed per year. - Proteetion of tribal CBNG from drainage beeause of resouree proteetion protoeols.		- Potential operational interference within and adjaeent to eoal mines. - Proteetion of tribal CBNG from drainage beeause of 5-mile buffer zone.
• State: - Irretrievable commitment of CBNG resourees from CX Raneh Field produetion. - Delayed development or expansion of conventional oil and gas, eoal mining and surfaee mineral mining in minor instanees with no interruption to existing aetivities.	• State: - Inereased commitment of CBNG resourees due to increased level of CBNG. - Mineral drainage and seismic interference issues same as for Federal under this alternative	• State: - Same as Alternative B. - Potential mineral drainage between federal mineral estates and state, private, or Tribal developments depending on site-speeifie conditions.	• State: - Same as Alternative B. - Potential mineral drainage between Federal mineral estates and state, private or Tribal developments depending on site-specifie conditions.	• State: - Same as Alternative B. - Potential mineral drainage between federal mineral estates and state, private or Tribal developments depending on site-specifie conditions.	• State: - Increased commitment of CBNG resourees due to increased level of CBNG development. - Potential mineral drainage between federal mineral estates and state, private and tribal developments depending on site-speeifie conditions.	• State: - The same as F, but approximately 65% lower.	• State: - Inereased eommitment of CBNG resourees due to inereased level of CBNG development. - Potential mineral drainage between federal mineral estates and state, private and tribal developments depending on site-specifie eonditions.

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Geology and Minerals (cont.)							
- CBNG production dewatering at nearby coal seams, in rare occurrences can cause underground coal fires, methane seeps and the liberation of methane to water wells.					- Presence of shallow CBNG production could delay certain types of seismic prospecting for conventional oil and gas reservoirs.		- Presence of shallow CBNG production could delay certain types of seismic prospecting for conventional oil and gas reservoirs.
• Cumulative Impacts: - Reduction in Coal resources from current and planned surface mine operations. - Potential CBNG drainage along Wyoming Montana State Line.	• Cumulative Impacts: - Increase in wells and infrastructure could impact existing mine expansion greater possibility of CBNG drainage than A.	• Cumulative Impacts: Impacts increased over alternative B.	• Cumulative Impacts: - Same as Alternative B.	• Cumulative Impacts: Similar to Alternative B. - Potential mineral drainage between federal mineral estates and state, private, or tribal developments depending on site-specific conditions.	• Cumulative Impacts: Similar to Alternative B. - Increased potential mineral drainage of federal mineral estates by state, private, or tribal developments depending on site-specific conditions.	• Cumulative Impacts: Similar to Alternative B, but lower based on less development.	• Cumulative Impacts: Similar to Alternative B. - Increased potential mineral drainage of federal mineral estates by state, private, or tribal developments depending on site-specific conditions

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Hydrological Resources *Surface water: The Tongue River has generally good quality water with a seasonal flow consistent from year to year and is frequently used for irrigation The Powder and Little Powder Rivers are characterized as having fair to poor quality water and can and do go dry, the waters are used for stock and limited irrigation.* *Groundwater: Regional groundwater is available in stream bottoms and alluvium, but becomes scarce away from the water course. Coal beds and interlayered sands are the most commonly used aquifers away from riparian areas. Groundwater quality is variable and effects taste and beneficial uses.* *Beneficial Reuse: The southeastern region of Montana is classified as a high plains semi-arid environment and has experienced drought conditions over much of the last decade*							
• Federal: - No impacts to surface or groundwater resources. - No beneficial reuse. • State: - Negligible increase in surface water flow and quality changes in the Tongue River. No change in other waterways. - Groundwater drawdown within the immediate vicinity of the CX Ranch. - Continued beneficial reuse of produced water at the CX Ranch.	• Surface Water - Similar to Alternative A; potential for increased sediment loads due to soil disturbance and erosion.	• Surface Water - Surface water quality in some watersheds would be noticeably altered, resulting in restricted downstream uses. - Surface water flow would be considerably increased in some watersheds causing persistent riparian erosion, changes in watercourses and increased sedimentation.	• Surface Water - Similar to Alternative A; potential for increased sediment loads due to soil disturbance and erosion. - Surface water flow would be similar to Alternative C but with slight increase in volume due to reduced conveyance loss.	• Surface Water - Surface water quality would be slightly altered, however downstream uses would not be diminished. - Surface water flow would be moderately increased causing some riparian erosion, as well as increased sedimentation.	• Surface Water: - Water quality would be slightly altered; downstream uses would not be diminished. - Surface water flow would be moderately increased, causing some riparian erosion, as well as increased sedimentation.	• Surface Water: - Water quality would be slightly altered; however, downstream uses would not be diminished. - Flows would slightly increase resulting is slight riparian erosion, as well as minor increases in sedimentation.	• Surface Water: - Water quality will be slightly altered; however downstream uses would not be diminished. - Surface water flow would be moderately increased, causing some riparian erosion, as well as increased sedimentation.

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Hydrological Resources (cont.)							
	• Groundwater: - Groundwater will be drawn down over time in the Powder River Basin. - Isolated areas of development would experience an increased drawdown effect. - Immediate drawdown of coal seam aquifers would be minor and limited in horizontal extent. As CBNG production matures, coal seam aquifer drawdown could reach 20 feet 4 to 5 miles from the edge of production. - No change in groundwater quality.	• Groundwater: - Drawdown same as Alternative B. - Alluvial groundwater quality would be altered due to infiltration of untreated production water.	• Groundwater: - Drawdown same as Alternative B - No groundwater quality impacts.	• Groundwater: - Drawdown same as Alternative B. - Minor impacts to shallow groundwater quality from impoundment infiltration and surface discharge of some untreated production water.	• Groundwater: - Drawdown same as Alternative B. - Minor impacts would occur to shallow groundwater quality from impoundment infiltration and other water management practices.	• Groundwater: - Drawdown effects near CBNG fields would be the same as Alternative B, but fewer CBNG fields would be developed. - Minor impacts to shallow groundwater quality would occur from impoundment infiltration and other water management practices.	• Groundwater: - Drawdown same as Alternative B. - Minor impacts would occur to shallow groundwater quality from impoundment infiltration and other water management practices.

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Hydrological Resources (cont.)							
• Beneficial Reuse: - Due to the increased water volumes from Wyoming's discharge there would be added opportunities for irrigation, stock watering and other uses from waterways, depending on the water quality.	• Beneficial Reuse: - Same as Alternative A.	• Beneficial Reuse: - Same as Alternative A.	• Beneficial Reuse: - Increased availability of treated water for a variety of downstream and increased beneficial uses, estimated at 20% of production.	• Beneficial Reuse: - Required Water Management Plans from all operators would result in increased beneficial reuse of production water, estimate at 20%.	• Beneficial Reuse: - Required WMPs from all operators would result in beneficial reuse of approximately 20% of production water.	• Beneficial Reuse: - Required WMPs from all operators would result in beneficial reuse of approximately 20% of production water.	• Beneficial Reuse: - Required WMPs from all operators would result in beneficial reuse of approximately 20% of production water.
• Cumulative Impacts: - Surface Water: Wyoming's discharge of CBNG production water would result in moderate increases in surface water flow in Montana rivers depending on the season and watershed from minor to noticeable amounts.	• Cumulative Impacts: - Surface water flow and quality will be the same as Alternative A. - CBNG production in Montana and Wyoming will noticeably drawdown coal seam aquifers. - Groundwater quality in Montana and beneficial reuse will be the same as Alternative A.	• Cumulative Impacts: - Surface water quality in some watersheds would be noticeably altered, resulting in restricted downstream uses.	• Cumulative Impacts: - Surface water quality would not be degraded and minor impacts from Wyoming would be diluted. - Surface water flow impacts would be similar to Alternative C with added volume due to reduced conveyance loss.	• Cumulative Impacts: - Cumulative impacts to surface water will be reduced dependent on MDEQ numerical and narrative standards. - Surface water quality would be slightly altered however downstream uses would not be diminished. - Surface water flows would be moderately increased in some watersheds and provide a source of flow in some rivers that would otherwise have gone dry seasonally.	• Cumulative Impacts: - Cumulative impacts to surface waters would be lower than MDEQ standards. - Surface water quality would be slightly altered; however, downstream uses would not be diminished - Surface water flows would be moderately increased.	• Cumulative Impacts: - Cumulative impacts to surface waters would be lower than MDEQ standards. - Surface water quality would be slightly altered; however, downstream uses would not be diminished - Surface water flows would be only slightly inereased due to fewer wells developed.	• Cumulative Impacts: - Cumulative impacts to surface waters would be lower than MDEQ standards. - Surface water quality would be slightly altered; however, downstream uses would not be diminished - Surface water flows would be moderately increased.

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Hydrological Resources (cont.) - The surface water quality in the three-shared rivers between Montana and Wyoming would be slightly altered, however downstream uses will not be diminished. – TRR construction could lead to localized soil erosion and impact to surface water focused runoff, localized increased stream flow and increased suspended sediment. - Groundwater: Drawdown of groundwater from Wyoming CBNG operations could extend several miles north into Montana. - Groundwater quality in Montana would not be impacted by Wyoming CBNG operations - Drawdown from the CX Ranch may extend out several miles from the development.		- Surface water flow would be considerably increased in some watersheds causing persistent riparian erosion, changes in watercourses and increased sedimentation. - Impacts to groundwater drawdown, quality and beneficial reuse would be the same as in Alternative B.	- Impacts to groundwater drawdown and quality would be the same as in Alternative B. - Increased beneficial reuse, estimated at 20% of production.	- Impacts to groundwater drawdown would be the same as Alternative B. - Shallow groundwater quality would be slightly altered due to impoundment infiltration and surface discharge of untreated production water. - Use of Water Management Plans and agency approval would result in increased beneficial reuse, estimated at 20%.	- Minor impacts would occur to shallow groundwater quality from impoundment infiltration and other water management practices.	- Drawdown effects near CBNG fields would be the same as for Alternative B, but fewer CBNG fields would be developed. - Minor impacts would occur to shallow groundwater quality from impoundment infiltration and other water management practices.	- Groundwater drawdown would be similar to Alternative B. - Minor impacts would occur to shallow groundwater quality from impoundment infiltration and other water management practices.

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Indian Trust and Native American Concerns *Indian Trust Assets (ITAs) are official interests in assets held in trust by the federal government for Indian tribes or individuals. The U.S. Department of the Interior (DOI) Departmental Manual 303 DM 2 defines ITAs as lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians.*							
• Federal: - No measurable impacts to Indian trust assets would occur from the CBNG activities.	• Federal: - No surface water quality impacts foreseen. - Potential CBNG drainage, dependent on specific site conditions, delayed by buffer zone. - Visibility impacts. - Wildlife Adaptation resulting in changes. - Potential cultural resource impacts to TCPs.	• Federal: - Potential for surface water quality and quantity impacts. - Potential CBNG drainage, same as Alternative B. - Cultural Resource impacts same as B. - Visibility impacts.	• Federal: - Groundwater drawdown same as Alternative B. - Surface water quality impacts reduced by source treatment, increased availability of surface waters for irrigation and other beneficial uses. - Increased surface water flow could result in increase riparian erosion. - Potential CBNG drainage, same as Alternative B. - Cultural Resource impacts same as B. - Visibility impacts.	• Federal: - Effects from groundwater drawdown mitigated because of resource protection protocols. Potential CBNG drainage mitigated through the use of resource protection protocols. - Surface water quality impacts reduced with increased availability of surface waters for irrigation and other beneficial uses. - Increased surface water flow could increase riparian erosion. - Air Quality and visibility impacts alleviated through site specific permits and mitigation.	• Federal: - Potential effects from groundwater drawdown would be reduced by implementation of a 5-mile buffer zone. Potential CBNG drainage would be mitigated or eliminated. - Surface water quality impacts would be reduced through implementation of water screen and 5-mile buffer. - TCP site would be identified sooner through use of block surveys and tribal consultations. - Air Quality impacts would be mitigated through site-specific permits and control measures.	• Federal: - Potential impacts from Alternative G would be similar to Alternative F, except approximately 65% lower due to reduced number of APDs predicted to be issued. - Surface water quality impacts would be similar to Alternative F although approximately 65% would be reduced due to fewer wells developed. - TCP site would be identified sooner through use of block surveys and tribal consultations. - Air quality impacts would be mitigated through site-specific permits and control measures.	• Federal: - Potential effects from groundwater drawdown would be reduced by implementation of 5-mile buffer zone. Potential CBNG drainage would be mitigated or eliminated. - Surface water quality impacts would be reduced through implementation of water screen and 5-mile buffer. - TCP site would be identified sooner through use of block surveys and tribal consultations. - Air Quality impacts would be mitigated through site-specific permits and control measures.

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Indian Trust and Native American Concerns (cont.)							
• State: - No measurable impacts to Indian trust assets would occur from the CBNG activities.	• State: - Groundwater drawdown inward from reservation boundaries. - Limited short-term surface water impacts from spills and ruptures adjacent to reservations. - Potential CBNG drainage, dependent on specific site conditions, no delay due to adjacent development.	• State: - Groundwater drawdown same as Alternative B. - Surface water quality and quantity impacts. - Potential CBNG drainage, same as Alternative B.	• State: - Groundwater drawdown same as Alternative B. - Surface water quality impacts reduced. - Potential CBNG drainage, same as Alternative B.	• State: - Surface water quality protected.	• State: - Same as Alternative E.	• State: - Same as Alternative E.	• State: - Groundwater drawdown potential on reservations would be minimized. CBNG drainage would be minimized by state spacing. Surface water quality would be protected.

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Indian Trust and Native American Concerns (cont.)							
• Cumulative Impacts: - Reduction in Coal resources from the Absaloka Mine operation. - Surface water quality and quantity in the Tongue River would not be noticeable altered from Wyoming CBNG development. - Drawdown of groundwater from Wyoming CBNG operations has the potential to lower aquifer levels on the Crow Reservation. - Potential CBNG drainage along southeastern corner of Crow Reservation from Wyoming operations.	• Cumulative Impacts: - Same as Alternative A. - Reduction of CBNG resources if developed by Tribes, coupled with land disturbances and associated water impacts. - Changes in visibility. - Air Quality changes. - Potential air quality impacts to PSD class I 24-hour PM_{10} increments. - Potential air quality impacts to PSD Class I annual NO_2 increments.	• Cumulative Impacts: - Same as Alternative B.	• Cumulative Impacts: - Same as Alternative B except no potential air quality impacts to PSD Class I annual NO2 increments.	• Cumulative Impacts: - Same as Alternative B.	• Cumulative Impacts: - Would be same as Alternative B, except no potential air quality impacts to PSD Class I annual NO_2 increments.	• Cumulative Impacts: - Would be same as Alternative B, except reduced due to fewer wells developed.	• Cumulative Impacts: - Would be same as Alternative B, except no potential air quality impacts to PSD Class I annual NO_2 increments.

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Lands and Realty *Emphasis Area Land Ownership: Private 69%, Federal 15%, Tribal 10%, State 5%* *Total Acreage: 19,371,593*				*Miles of Road: Interstate, 386; US; 675; State, 409; Off-System, 24,431* *Miles of Railroad: BNSF, 573; MT Rail Link, 146*			
• Federal: - Minimal land area displaced by roads. - 400 acres disturbed short term during CBNG exploration drilling.	• Federal: - Increase fire hazard and motorized access during 20-year lease. - Limit public access. - Disrupt active logging operations. - 25,600 short term acres and 15,250 long term acres disturbed during CBNG development activities.	• All Federal and State impacts in Altemative B occur in Altemative C in addition to: - Impacts to adjacent mining operations The land use displacement from roads and utility lines lease operations is greatest in Alternative C.	• All Federal and State impacts in Altemative B occur in Alternative D in addition to the following: - Federal: Permanent loss of land use from road network.	• Federal and State: - Levels of disturbance would be slightly increased due to use of impoundments for production water management (Short term 74,000 acres, long term 44,000 acres). - Impacts from powerlines, roads, pipelines and other utilities not requiring transportation corridors would be the same as Alternative C.	• Federal: - 25,600 acres would be disturbed during CBNG exploration and construction activities (short term). - 15,250 acres would be disturbed during operation (long term).	• Federal: - 9,100 acres would be disturbed during CBNG exploration and construction activities (short term). - 5,400 acres would be disturbed during operation (long term).	• Federal: - 25,600 acres would be disturbed during CBNG exploration and construction activities (short-term). - 15,250 acres would be disturbed during operation (long-term).
• State: - Increased motorized access on the CX Ranch. - Increase motorized trespass. - 1,100 short term acres disturbed and 500 long term acres during CBNG exploration and production activities.	• State: - Displace agricultural lands and disrupt irrigation system, increase cost of farm operation. - Reduced property values. - Displace community and residential growth. - Increase dust and noise impacts on residential use.	- Increased disturbances by CBNG activities on private, state and federal estates. Short term disturbances 70,000 acres (Federal 32, 400, State 37,600); long term disturbances 47,600 acres (Federal 22,000, State 25,600).			• State: - 29,550 acres would be disturbed during CBNG exploration and construction activities (short term). - 17,600 acres would be disturbed during operation (long term).	• State: - 10,500 acres would be disturbed during CBNG exploration and construction activities (short term). - 6,250 acres would be disturbed during operation (long term).	• State: - 29,500 acres would be disturbed during CBNG exploration and construction activities (short-term). - 17,600 acres would be disturbed during operation (long-term).

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Lands and Realty (cont.)							
	- Increase cost of county road maintenance. - Increase long-term motorized access. - Invite illegal trespass activities. - Increase forest pests. - Disrupt active logging operations. - Increase motorized trespass. - 29,750 short term acres and 17,700 long term acres disturbed during CBNG development activities.						
• Total cumulative long term disturbance including all foreseen projects such as coal mine expansion, transportation etc. is estimated at 34,000 acres.	• Total cumulative acres disturbed long term including all foreseen projects would be approximately 81,000 acres.	• Total cumulative long term acres disturbed would be approximately 102,300 acres.		• Total cumulative long term acres disturbed would be approximately 92,200.	• 88,170 acres would experience cumulative effects.	• 20,450 acres would experience cumulative effects.	• 88,170 acres would experience cumulative effects.

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Livestock Grazing *AUM is equal to the amount of forage required to support one cow and her calf or 5 sheep for one month.* *The CBNG Planning Area has an estimated 1,389,908 acres of land classified as grazing, capable of supporting 259,554 AUMs.*							
• Exploration wells located within BLM-permitted rangelands would result in the temporary loss of 69 AUMs. • State: - The exploration wells and production wells located at CX Ranch would result in a maximum construction loss of 272 AUMs on state and private rangelands combined. - Re-vegetating parts of the well pads during production would reduce the state-permitted losses to 194 AUMs.	• Exploration wells would result in the temporary loss of 413 AUMs (BLM 163, State 250). • Production wells would result in a maximum construction loss of 11,960 AUMs (BLM 4,770, State 7,190). • Re-vegetating parts of the well pads during production would reduce the losses to 6,904 AUMs (BLM 2,484, State 4,420). • If all Alternative requirements were utilized fully, the area of surface disturbances could be reduced by an additional 35 percent during construction and 40 percent during production primarily because of required transportation corridors.	• Impacts to livestock grazing would be similar to but slightly greater than those in Alternative B due to the discharge of untreated production water on to the ground resulting in increased erosion and no requirements for transportation corridors. • CBNG discharge water could be used for livestock watering; increased erosion would result in increased surface disturbance, which could lead to disrupted grazing patterns, undermined fencing and reduced forage; an increase of noxious weeds and a decrease in forage material could occur if discharged produced water is too high in saline content; and possible health effects to livestock if produced water that is unsuitable for livestock watering.	• Impacts would be similar to Alternative B with some exceptions: disturbed acreage would increase due to the piping of discharge water to the nearest disposal point. There would be a reduction to forage losses from increased managed irrigation of produced water; and there would be less soil and forage loss from erosion of soils. • Transportation corridor and road impact causing reductions of surface disturbance would be similar to Alternative B.	• Impacts to livestock grazing would be similar to Alternative B. Suitable CBNG discharge water could be used for livestock watering. • Transportation corridor impacts would be the same as Alternative B. • Not as much forage would be lost under this alternative because increased managed irrigation of produced water would allow more growth. There would also be less soil and forage loss from soils erosion because more vegetation would hold the soils in place.	• Impacts to livestock grazing would be similar to Alternative B and phased in after watershed analysis. • WMPs for federal CBNG wells would incorporate results and requirements identified by watershed-level analysis. • Impacts from federal CBNG development would occur primarily in the latter years of the planning period, generally following state and private development.	• Impacts would be similar to Alternative B, but the land disturbance area would be approximately 65% lower.	• Impacts to livestock grazing would be similar to Alternative B. • CBNG PODs would be screened for four resources, of which water would have the most effect on livestock grazing. • Water Management Plans for federal CBNG wells would incorporate results and requirements identified by watershed-level analysis.

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Paleontological Resources *Paleontological resources consist of fossil-bearing rock formations that underlie the entire Planning Area. Fossil outcrops are relatively rare throughout the emphasis area, but know areas are protected.*							
• It is unlikely that any of the 1,500 short term acres disturbed during CBNG development activities would contain noteworthy paleontological resources. The 575-acre Bridger Fossil Area ACEC (only paleontological resource) would not be disturbed. • Other impacts would include vandalism and removal of fossils by amateur fossil collectors resulting from minor increased accessibility to remote areas.	• Impacts for Alternative B, C, D and E would be nearly the same based on level of disturbance, known locations of rich fossil areas, geological formation for paleontological features and protected ACECs. • There would be between 55,400 and 74,000 short term acres disturbed during CBNG development activities increasing the chances that a minor fossil discovery would be made. Cumulative impacts would disturb an additional 33,400 acres increasing the likelihood of additional fossil discoveries. • Increased access would include increased vandalism and removal of fossils by amateur fossil hunters.				Would be same as Alternatives B, C, D and E.	• Impacts would be similar to the other expanded alternatives with the exception that they would be reduced by approximately 65% due to fewer APDs predicted to be issued. • Between 19,400 and 25,900 short-term acres would be disturbed during CBNG development activities, increasing chances that a minor fossil discovery would be made. Cumulative impacts would disturb additional 11,700 acres, increasing likelihood of additional fossil discoveries.	• Implementation of paleontological inventories in areas of High Potential Fossil Yield Formations (See BLM Instruction Memorandum 2008-2009) would result in fewer impacts to palcontological localities since the recorded localities would be avoided.

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Paleontological Resources (continued)							
							• There would be between 55,400 and 74,000 short term acres disturbed during CBNG development activities increasing chances that a fossil discovery would be made. Cumulative impacts would disturb an additional 33,400 acres increasing likelihood of additional fossil discoveries.
Recreation *Montana's natural features offer a variety of year-round recreational opportunities*							
• Minor loss of land for recreation purposes and the disruption to recreation activities. • Exploratory activities such as drilling and testing would temporarily displace game species locally.	• Moderate loss of land for recreation purposes and the disruption to recreational activities. • Increased opportunities for access to remote areas.	• Impacts would be similar to Alternative B with the exception that increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.	• Impacts would be similar to Alternative B.	• Impacts would be similar to Alternative B with the exception that no requirements for transportation corridors would moderately increase access to remote areas.	• Impacts would be similar to those for Alternative B. • Impacts from federal CBNG development would occur differently than the other alternatives based on annual and watershed-based limits.	• Impacts would be similar to those for Alternative B in the sequence of development, but would result in lower impacts than other alternatives due to fewer wells developed.	• Impaets would be similar to or lower than Alternative B in the sequence of development, but could result in lower visual impacts than other alternatives due to usc of resouree screens and mitigation and management plans for development.

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Socio-Economics *Socio-economics address the changes in demographics; social organization including housing attitudes and lifestyles; economics such as employment, unemployment and per capita income; and, government revenue sources including taxes, state oil and gas lease income, federal mineral revenues and private landowner revenues.*							
• Few social impacts (only small changes in employment, population, demand for services, etc.). • Small impact on economic conditions as a result of new production wells.	• Most new CBNG jobs probably would be filled by workers commuting from Wyoming. If this occurred, social benefits and impacts could be lower than described below. • Social impacts would include new jobs and new population moving to the area. • Economic impacts include generation of new personal and government income. • Additional disposal costs associated with injection of produced water. • Additional demands on public services.	• Social impacts same as Alternative B, with increase in impacts on lifestyles and values. • Economic impacts same as Alternative B, with increase in impacts to water resource users.	• Social impacts same as Alternative B, with small increase in impacts on lifestyles and values. • Economic impacts same as Alternative B, with small increase in impacts to water resource users.	• Social impacts same as Alternative B, with the exception that public burden to maintain roads may increase depending on landowner access decisions. • Economic impacts same as Alternative B, except that oil and gas income may be less depending on water treatment costs.	• Because development is phased, it is likely that most new jobs would be filled by workers commuting from Wyoming. • Social impacts would be similar to those for Alternative B and lower than those for Alternatives C through E during certain years, but of longer duration due to phased development. • Economic impacts would be fewer than those for Alternatives B through E, but would be of longer duration due to the evening out of CBNG activities over the phased development period.	• Social impacts would be fewer than those for other development alternatives, with the duration of impacts similar to that for Alternative F due to phased development. • Economic impacts would be fewer than those for Alternatives B through F, with the duration of impacts similar to those for Alternative F due to phased development.	• Social and economic impacts similar to Alternative F due to similar rate of CBNG well development.

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Soils *Montana has a wide mix of geologic parent material, which produces a vast array of different soil types*							
• There would be minor occurrences of soil erosion, runoff and sedimentation, mostly during construction activities. • Approximately 1,500 acres would be disturbed short term during CBNG exploration and construction activities. • 500 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased.	• Soil disturbances could be reduced by 35 percent or higher on a per well basis over Alternative A. CBNG activities would result in 55,400 short term acres being disturbed. • 32,950 acres would be disturbed longer term during CBNG production, with a majority of the land reclaimed after production is ceased. • No impacts would occur to soils from CBNG waters.	• CBNG development activities would disturb corridors. Approximately 70,000 short term acres of disturbed surface area during construction activities. • Surface discharge and irrigation of produced water could result in approximately 47,600 acres disturbed in the long term.	• Impacts including levels of disturbance would be similar to Alternative B. • One favorable side effect would be that more water would be available for irrigation.	• Impacts would be similar to Alternative B. There would be a slight increase in the level of disturbance due to increased use of impoundments to contain produced water. Short term acres disturbed would be approximately 74,000 while long term would be 44,000. • Produced water would be available for beneficial use including irrigation. • No impacts are expected to occur on irrigated lands or soils	• Impacts would be similar to those for Alternative B, although some impacts would not occur or would be delayed due to implementation of cumulative and watershed-specific numerical limits on the number of federal CBNG APDs approved per year. • Produced water would be available for beneficial use, including irrigation.	• Impacts would be similar to those for Alternative B, although impacts would be fewer due to the limit on the number of federal CBNG APDs (323 versus 910) approved per year. • Produced water would be available for beneficial use, including irrigation.	• CBNG development would result in approximately 55,100 acres being disturbed. • An estimated 32,850 acres would be disturbed longer term during production, with most of the land reclaimed after production ceased. • No impacts would occur to soils from CBNG waters.

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Solid and Hazardous Wastes *Solid and hazardous wastes are under the jurisdiction of the MDEQ for RCRA wastes, MBOGC for RCRA exempt wastes and the EPA for wastes generated on tribal lands*							
• Typical solid waste refuse can be disposed of in local landfills. • Drilling mud and cuttings can be disposed of onsite with the landowner's permission. • Minor impacts would also occur from the use of pesticides and herbicides during access and construction activities. • Cumulative impacts from other foreseen projects would result in increased waste generated at moderate levels for commercial disposal.	• Impacts for Alternative B, C, D, E, F and G would include increased quantities of waste requiring onsite disposal or transportation to commercial landfills. • Oil and gas developers are responsible for any damages to property, real or personal, resulting from the lack of ordinary care during operations. Operators are required to maintain SPCC plans and immediately remove and spilled or unused non-exempt wastes from the sites therefore no long term impacts to private, state or federal lands would occur from waste products associated with CBNG development.						• Typical solid waste refuse could be disposed of in local landfills. • Drilling mud and cuttings could be disposed of onsite with the landowner's permission on private surface and on BLM-administered surface with agency approval. • Minor impacts would also occur from use of pesticides and herbicides during access and construction activities. • Impacts would include increased quantities of waste requiring on-site disposal or transport to commercial landfills. • Oil and gas developers would be responsible for any damages to property, real or personal, resulting from the lack of ordinary eare during operations. Operators must maintain SPCC plans and immediately remove any spilled or unused non-exempt wastes from the sites. • No long-term impacts to private, state, or federal lands would occur from waste produets associated with CBNG development.

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Vegetation *Emphasis area acreage by land classifications, overlying known coal reserves: Grasslands, 3.55 million (2.56 million in the FSEIS Planning Area); Shrublands, 1.8 million (1.66 million in the FSEIS Planning Area);* *Forests, 1.36 million (1.29 million in the FSEIS Planning Area); Riparian Areas, 378,000 (268,000 in the FSEIS Planning Area); Barren Lands, 372,000 (297,000 in the FSEIS Planning Area); and Other Areas, 700,000 (345,000 in the FSEIS Planning Area) Forty BLM sensitive plant species have been recorded in one or more of the Planning Area counties.*							
• 1,142 acres of native habitat would be impacted under this Alternative, more than half (580 acres) in grasslands	• 55,400 acres of native habitat could be impacted short term under this Alternative, more than half (21,450 acres) in grasslands.	• 70,000 acres of native habitat could be impacted short term under this Alternative, more than half (27,300 acres) in grasslands.	• Native habitat disturbances would be similar to those discussed under Alternative B.	• Impacts would be similar to those for Alternative D, however no riparian habitat would be affected. Short term impacts would be slightly increased (74,000 acres) due to the use of impoundments for water management practices.	• Impacts would be similar to those for Alternative B. • Resource impacts from proposed development projects would be evaluated on a watershed-level basis.	• Impacts would be similar to those for Alternative B, but the land disturbance area would be approximately 65% lower.	• Impacts would be similar to those for Alternative B. • Resource impaets from proposed development projects would be evaluated on a watershed-level basis. • Use of resource screens and watershed-based limits on federal CBNG development would result in spatial and temporal distribution of impacts similar to Alternative F.

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Vegetation (cont.)							
• Potential minor loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be slightly impacted by disturbances. • No federal threatened or endangered plant species are known to occur within the Planning Area.	• Potential moderate loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be impacted by disturbances. • No federal threatened or endangered plant species are known to occur within the Planning Area.	• If SAR values exceed 10 in water, riparian vegetation would be impacted, affecting as many as 3,535 acres of riparian habitat. • Potential loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be impacted by disturbance, SAR values and water level changes, particularly inundation. • No federal threatened or endangered plant species are known to occur within the Planning Area.	• Hydrology changes may affect as much as 2,776 acres of riparian habitat due to increased stream flow. • Potential loss of plant diversity with reclamation. • On non-federal land, Ute ladies'-tresses could be impacted by disturbance and water level changes, particularly inundation. • No federal threatened or endangered plant species are known to occur within the Planning Area.	• No federal threatened or endangered plant species are known to occur within the Planning Area.	• Annual and watershed-based limits on federal CBNG development would result in a different spatial and temporal distribution of impacts than for the other development alternatives. • Watershed-based analysis would limit the amount of disturbed habitat on BLM-administered surface or on private surface overlying federal minerals within each fourth order watershed, based on the potential to affect species of special concern from habitat fragmentation. • No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.	• No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.	• Watershed-based analysis would limit the amount of disturbed habitat on BLM-administered surface or on private surface overlying federal minerals within each 4th order watershed, based on the potential to affect species of special concern from habitat fragmentation. • No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Alternative A—No Action (Existing CBNG Management)	Alternative B—CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBNG Development	Alternative D—Encourage CBNG Exploration and Development While Maintaining Existing Land Uses	Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses	Alternative F—Phased Development Multiple Screens (High Range)	Alternative G—Phased Development Multiple Screens (Low Range)	Alternative H—Preferred Alternative - Multiple Screens
Visual Resource Management *Visual resources include Montana features such as landform, water, vegetation, color, adjacent scenery, uniqueness, structures and man-made features of aesthetic value*							
• Federal and State: - Dust emissions would reduce visibility to a small degree near active field operations. - Well pads, roads and compressors would disrupt the visual landscape. Semi-permanent structures are designed to blend into the surrounding environment. - Drill rigs, two-track trails, heavy road-making equipment and generators would disrupt the visual landscape short-term.	• Federal: - There would be impacts to VRM BLM Class III and IV areas only. • Type of impacts common to Alternative A would occur with Alternative B, though at a scale commensurate with development. • View shed impacts from road network would last for 20 years and then reclaimed.	• Impacts common to Alternative B would occur with Alternative C, in addition to the following: • Above ground powerlines would greatly impact skyline and viewshed. • Visual impacts from roads and utility lines is greatest with this alternative until reclamation.	• Impacts common to Alternative B would occur with Alternative D, in addition to the following: • Production related roads that are not reclaimed and made part of the permanent road network would result in permanent visual impact.	• Impacts would be reduced from Alternative C by the mitigation measures in the Project POD for visual resources. • Impacts would be mitigated as described under the Alternative B, Mitigation subsection.	• Impacts would be similar to those for Alternative E. • Locations and levels of impacts would vary compared to other alternatives based on annual and watershed-based federal CBNG development limits.	• Impacts would be similar to those for Alternative E in the sequence of development, but would result in lower impacts than other action alternatives.	• Impacts would be similar to or less than Alternative E in the sequence of development, but could result in fewer visual impacts than other alternatives due to screening process and use of mitigation and management plans for development.

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Wilderness Study Areas *There are 10 WSAs within the CBNG emphasis area (6 in the FSEIS Planning Area)*							
• BLM WSAs are closed to oil and gas leasing so there would be no direct impacts to WSAs.	• There would be no direct impacts to WSAs from CBNG development.	• Same as Alternative B.	• Same as Alternative B.	• Same as Alternative B. • There would be no direct impacts to WSAs from CBNG development. • Laws and regulations established for WSAs prohibit leasing of WSAs designated lands for resource extraction.	• No direct impacts to WSAs would be expected from phased CBNG development.	• Same as Alternative F.	• No direct impacts to WSAs would be expected from CBNG development.
Wildlife *Mammal Species:* *- 10 bats* *- 8 Shrews* *- 34 small mammals* *- 17 predators* *- 4 big game*	*Bird Species:* *- 32 waterfowl* *- 33 shore & wading birds* *- 18 diurnal &* *- 11 nocturnal raptors* *- 8 gallinaceous* *- 8 woodpeckers* *- 137 songbirds*	*Reptiles and Amphibian species* *- 1 salamander* *- 4 frogs* *- 4 toads* *- 3 turtles* *- 2 lizards* *- 9 snakes*	*Species of Concern consist of 16 mammals, 9 reptiles and amphibians and 22 birds, including:* *- Sage-grouse* *- Interior Least Tern* *- Gray Wolf* *- Canada Lynx* *- Grizzly Bear* *- Mountain Plover* *- Bald Eagle* *- Peregrine Falcon* *- Black-tailed Prairie Dog* *- Black-footed Ferret*				
• Direct and indirect impacts would occur at a level commensurate with the level of CBNG development. • Direct impacts include habitat loss, death from vehicle collisions and effects associated with greater human access into previously untraveled areas.	• Same as Alternative A but on a much larger scale. Twenty-five times as many wells, roads and utility corridors as under Alternative A. • 6,680 miles of roads (2.9 to 8.8 miles per square mile).	• Direct and indirect impacts would occur at a level commensurate with the level of CBNG development. Indirect impacts to wildlife on 884,000 to 4.7 million acres from:-	• Impacts would be similar to Alternative B. • Discharged treated CBNG water would erode riparian and wetland habitat. • Increased livestock grazing within 2 miles of CBNG discharges that occur in areas without summer water.	• Direct and indirect impacts would occur similar to Alternative B. • Indirect impacts to wildlife would occur on 884,000 to 4.7 million acres depending on development spacing. • Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal.	• Direct impacts would be fewer than for other development alternatives due to implementation of the wildlife screen. • Indirect impacts would be fewer than for other development alternatives due to implementation of the wildlife screen.	• Direct impacts would be similar to Alternative F, but reduced by approximately 65% due to wells being developed. • Indirect effects from new roads and new utility lines would be lower than for all other development alternatives due to fewer wells being developed.	• Direct and indirect impacts under Alternative H would be reduced relative to other development alternatives due to conditions placed on development within defined crucial sage-grouse habitat areas, use of BMPs and adaptive management.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Alternative A—No Action (Existing CBNG Management)	Alternative B—CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBNG Development	Alternative D—Encourage CBNG Exploration and Development While Maintaining Existing Land Uses	Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses	Alternative F—Phased Development Multiple Screens (High Range)	Alternative G—Phased Development Multiple Screens (Low Range)	Alternative H—Preferred Alternative - Multiple Screens
Wildlife (cont.)							
	• 20,697 miles of utility corridors (9 to 27.1 miles per square mile). • Indirect impacts to wildlife on 884,000 to 4.7 million acres. • Additional types of impacts include loss of high value habitats such as prairie dog towns, sage-grouse leks and big game winter range.	- 9,018 miles of roads (3.9 to 11.9 miles per square mile). - 27,917 miles of utility corridors (12.2 to 36.6 miles per square mile).	• Through mitigation, this Alternative would not directly impact any T&E listed wildlife species.	• Increased livestock grazing within 2 miles of CBNG discharges that occur in areas without summer water.			• Indirect effects from new roads and new utility lines would be similar to Alternatives B and D, but fewer than for Alternatives C and E while federal restrictions are applied.
• Indirect impacts on wildlife include disturbance and displacement, stress, power lines, noxious weed invasion, user-created roads, habitat fragmentation, water quality degradation from road runoff and increased livestock grazing. • Indirect impacts on wildlife would occur on 33,840 to 84,000 acres.	• Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal. Through mitigation, this Alternative would not directly impact any T&E listed wildlife species.	• Discharge of untreated CBNG water into drainages would impact riparian and wetland habitat and associated species because of poor water quality and erosion. • Increased livestock grazing within 2 miles of CBNG discharges that occur in areas without summer water.	• Potential indirect impacts to T&E species, such as human disturbance, or collisions with vehicles, would occur at a level less than Alternative C.	• Through implementation of WMPP impacts to T&E listed species would be minimized. - Species of concern not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment. - These impacts would be less than alternative B, C and D through the implementation of the WMPP. This alternative would include more holding ponds than any other development alternative, Consequently, it would include a greater risk of WNV infection to sage-grouse than any other development alternative.	• Species of concern not federally protected may be impacted by habitat loss, disturbance and habitat changes, but impacts would be minimized due to implementing the wildlife screen.	• Impacts to species of concern would be similar to Alternative F, but would be reduced by approximately 65% due to fewer wells being developed.	• Thresholds for important sagebrush-steppe habitat impacts could result in slightly fewer impacts to wildlife relative to other development alternatives, particularly sage-grouse and other sagebrush-steppe species

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Alternative A— No Action (Existing CBNG Management)	Alternative B— CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C— Emphasize CBNG Development	Alternative D— Encourage CBNG Exploration and Development While Maintaining Existing Land Uses	Alternative E— CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses	Alternative F— Phased Development Multiple Screens (High Range)	Alternative G— Phased Development Multiple Screens (Low Range)	Alternative H— Preferred Alternative - Multiple Screens
Wildlife (cont.)							
	• Potential indirect impacts to T&E species, such as human disturbance, or collisions with vehicles, could occur. Impacts would be less than C or D with the restricting of utilities and roadways to the same corridor.	• Through mitigation, this Alternative should not directly impact any T&E listed wildlife species.	• Potential indirect impacts to T&E species from hydrology changes caused by increased water levels may impact nesting Interior Least Terns. If hydrology changes from surface water runoff cause riparian vegetation changes, other T&E species may be impacted as well, such as nesting Bald Eagles.	- More water would be available for wildlife as a result of CBNG production. •An adaptive management strategy included as part of the WMP would help minimize impacts to wildlife and habitat by using new information to change or form additional conditions of approval.	• Thresholds for important sagebrush-steppe habitat impacts could result in slightly fewer impacts to wildlife relative to other development alternatives, particularly sage-grouse and other sagebrush- and grassland-associated species.		
• Through mitigation, this Alternative would not directly impact any T&E listed wildlife species. Potential indirect impacts to T&E species, such as human disturbance, or collisions with vehicles, would be low because of the limited number of CBNG wells permitted.	• All species of concern not federally protected may be impacted by habitat changes caused by vegetation removal or access roads not fully recovered with reclamation after well abandonment and by increased access through increased roads.	• Potential indirect impacts to T&E species, such as human disturbance, or collisions with vehicles, are greater under this Alternative than any other because of the increased number of CBNG wells permits.			• Impacts to sage-grouse populations in crucial habitat areas would be lower in this alternative because CBNG development in crucial habitat areas would be allowed only when operators could demonstrate retention of existing populations (as defined).	• Potential indirect impacts from human disturbance or collisions with vehicles would be reduced by approximately 65% from other development alternatives due to fewer wells being developed.	Similar to Alternative F. In the long term, impacts are expected to be the same as F; however, some level of impact that is greater than F may occur within the short-term (<5 years).

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Wildlife (cont.)							
• Species of concern not federally protected may be impacted by habitat changes caused by vegetation removal or access roads not fully reclaimed after well abandonment.		• Potential indirect impacts to T&E species from changes in riparian habitat due to increased SAR values and hydrology are likely to occur under this Alternative. Bald Eagles and Interior Least Terns may also be affected if SAR changes affect forage fish. • Species of concern not federally protected may be impacted by habitat changes caused by vegetation removal or access roads not fully reclaimed after well abandonment or by changing streambed hydrology and increased SAR and salinity values in water and soil. • More water would be available for wildlife.	• Species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal or access roads that are not fully recovered with reclamation after well abandonment or by changing streambed hydrology.			• Alternative G includes an adaptive management strategy which would help to minimize impacts to wildlife and habitats.	• Species of concern not federally protected may be impacted by habitat loss, disturbance and habitat changes. These impacts may be lower than under the other development alternatives due to established habitat, well development thresholds and implementation of the Wildlife Monitoring and Protection Plan and the wildlife screen.

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Wildlife (cont.)					• Potential indirect impacts such as human disturbance, or collisions with vehicles, would be lower than those for other development alternatives due to implementation of the Wildlife Monitoring and Protection Plan, and well development thresholds. • Alternative F would include an adaptive management strategy. This would minimize impacts to wildlife and habitats.		• Potential indirect impacts such as human disturbance, or collisions with vehicles, would be lower than those for other development alternatives due to implementation of the Wildlife Monitoring and Protection Plan, and well development thresholds. • Alternative H would include an adaptive management strategy. This would minimize impacts to wildlife and habitats.

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Wildlife (Aquatic Resources) *Fish species vary between watersheds within the CBNG emphasis area from 8 in the Little Big Horn River to 47 in the Yellowstone River*		*Special Status Aquatic Species:* *- Montana Arctic grayling* *- Pallid sturgeon*		*Species of Special Concern/BLM sensitive species:* *- Blue sucker* *- Paddlefish* *- Sauger* *- Yellowstone cutthroat trout* *- Northern redbelly X Finescale dace* *- Pearl Dace* *- Sturgeon chub*			
• Minor short-term impacts on aquatic resources during CBNG exploration and production may result from increased sediment delivery and its effects on aquatic habitat and organisms, possible impedance of fish movements, potential for accidental spills of petroleum products and possibly increased fish harvest. • Relatively minor long-term increases in river flow and TDS concentration from production water discharge would not be expected to impact aquatic resources.	• The same types of impacts described for Alternative A (No Action) would occur under Alternative B. • The scale of potential impacts associated with sediment delivery, fish movements, petroleum spills and fish harvest would be much greater under Alternative B because of the development of over 18,000 CBNG wells across a much larger geographic area. • No CBNG production water would be discharged to surface drainages under Alternative B and there would be no potential for impacting aquatic resources from this particular activity.	• The same types of impacts described for Alternative A would occur under Alternative C, but they would occur on a far greater scale because of the development of over 16,000 CBNG wells. • A total of 0.67 billion cubic feet of untreated CBNG production water would be discharged to drainages each year. Resultant flow and TDS increases could potentially impact aquatic organisms, especially in smaller drainages during dry times of the year.	• The same types of impacts described for Alternative A would occur under Alternative D, but they would occur on a far greater scale because of the development of over 16,000 CBNG wells. • The annual discharge of 2.24 billion cubic feet of treated CBNG production water through pipelines or constructed water courses and resultant flow increases could impact aquatic resources in smaller drainages during dry times of the year.	• The same types of impacts described for Alternative A would occur under Alternative E, but they would occur on a greater scale because of the development of over 18,000 CBNG wells. • The potential for affecting aquatic resources would be greater under Alternative E than under Alternatives B or D, but less than under Alternative C. • Pipelines or constructed water courses for the conveyance of CBNG-produced water and resultant flow increases could impact aquatic resources in smaller drainages during yearly dry periods. • About 2.24 billion cubic feet of CBNG production water would be managed through flexible options, but would allow no degradation of water quality (including thermal criteria).	• The same types of impacts described for Alternative A would occur under Alternative F, but the impacts would occur on a greater scale because of the development of more than 16,000 producing CBNG wells. • The potential for affecting aquatic resources would be greater under Alternative F than under Alternatives B or D, but lower than under Alternative C.	• The approximate 6,500 CBNG wells are about 65% fewer than the other action alternatives, resulting in a lower overall impact. • The effects on aquatic resources would be similar in nature to those for Alternative F, but substantially fewer than those for Alternative F due to fewer wells being developed. • About 0.78 billion cubic feet of CBNG production water would be managed through flexible management options, thus reducing the volume of untreated water discharged to surface waters.	• The same types of impacts described for Alternative A would occur under Alternative H, but the impacts would occur on a greater scale because of the development of more than 16,000 producing CBNG wells. • The potential for affecting aquatic resources would be greater under Alternative H than under Alternatives B or D, but lower than under Alternative C.

TABLE 2-3
COMPARISON SUMMARY OF IMPACTS

Alternative A—No Action (Existing CBNG Management)	Alternative B—CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources	Alternative C—Emphasize CBNG Development	Alternative D—Encourage CBNG Exploration and Development While Maintaining Existing Land Uses	Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses	Alternative F—Phased Development Multiple Screens (High Range)	Alternative G—Phased Development Multiple Screens (Low Range)	Alternative H—Preferred Alternative - Multiple Screens
Wildlife (Aquatic Resources)(cont.)				• The required WMPs and MPDES permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected. • The potential for affecting aquatic resources in sensitive drainages would be greater than for Alternatives B and D, but lower than under C. • Implementation of Wildlife Monitoring and Protection Plan would reduce impacts to aquatic habitat wildlife and invertebrates.			

TABLE 2-3
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Wildlife (Aquatic Resources)(cont.)							
• Conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges. • Impacts from CBNG abandonment would be minor and subside over time.	• Based on fish species present, fisheries management policies, fisheries resource values and the projected intensity of CBNG development, the drainages most sensitive to the effects of CBNG development would be the Lower Bighorn, Upper Tongue and Little Bighorn; then the Lower Tongue, Little Powder and Rosebud; followed by the Mizpah. • The potential for affecting aquatic resources in sensitive drainages would be less under Alternative B than under Alternatives C or D.	• Conditions of MPDES Permits would provide legally enforceable assurances preventing the degradation of water quality, aquatic resources and the beneficial uses of receiving waters. • The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative C than under Alternatives B or D.	• The treatment of CBNG production water prior to its discharge would greatly reduce the potential for elevated TDS and salinity impacts on aquatic resources. • MPDES Permits would provide legal assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected. • The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative D than under Alternative B but less than under Alternative C.		• Pipelines or constructed water courses for the conveyance of CBNG-produced water and resultant flow increases could impact aquatic resources in smaller drainages during yearly dry periods. • About 2.24 billion cubic feet of CBNG production water would be managed through flexible options, but no degradation of water quality would be allowed (including thermal criteria). Required WMPs and MPDES permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected.	• MPDES permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected. • Would limit CBNG development and total disturbed habitat annually and by watershed. • A sequential and controlled development schedule, combined with watershed-level analysis, would provide a framework for assessing potential impacts through a systematic monitoring program. • Would incorporate an adaptive management approach in the phased development process by using relevant monitoring data.	• Pipelines or constructed water courses and resultant flow increases could impact aquatic resources in smaller drainages during dry times of the year. • About 2.24 billion cubic feet of CBNG-produced water would be managed through flexible options, but no degradation of water quality would be allowed (including thermal criteria). • Required WMPs and MPDES permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected.

TABLE 2-3
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Wildlife (Aquatic Resources)(cont.)					• Potential for affecting aquatic resources in sensitive drainages would be greater than for Alternatives B and D, but lower than for C. • Would incorporate an adaptive management approach in the phased development process by using relevant monitoring data.		• The potential for affecting aquatic resources in sensitive drainages would be greater than for Alternatives B and D, but lower than for C. • Would incorporate an adaptive management approach in the phased development process by using relevant monitoring data.

CHAPTER 3

AFFECTED ENVIRONMENT

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CHAPTER 3: AFFECTED ENVIRONMENT

Introduction

This chapter contains a description of the natural resources, economic and social conditions found in the Planning Area, including the two Indian reservations that lie within the Planning Area boundary.

Air Quality and Climate

The air quality of any region is controlled primarily by the magnitude and distribution of pollutant emissions and the regional climate. The transport of pollutants from specific source areas is affected by local topography and meteorology. In the mountainous western U.S., topography is particularly important in channeling pollutants along valleys, creating upslope and downslope circulations that may entrain airborne pollutants and blocking the flow of pollutants toward certain areas. In general, local effects are superimposed on the general synoptic weather regime and are most important when the large-scale wind flow is weak.

Topography

The SEIS Planning Area is located in the northern portion of the Powder River Basin of the northwestern Great Plains Steppe in southeastern Montana. The Great Plains Steppe is a large physiographic province extending throughout most of eastern Montana, Wyoming and Colorado, as well as portions of western North and South Dakota, Nebraska, Kansas and the Oklahoma panhandle. The topography of the Planning Area varies from moderately steep to steep mountains and canyons in the western portions, to rolling plains and tablelands of moderate relief (with occasional valleys, canyons and buttes) in the eastern regions. Elevations generally range from about 3,000 to 7,000 feet above mean sea level, with mountain peaks rising to over 10,000 feet in the southwestern portion of the Planning Area.

Climate and Meteorology

Because of the variation in elevation and topography throughout the Planning Area, climatic conditions will vary considerably. Most of the area is classified as a semiarid cool steppe, where evaporation exceeds precipitation, with relatively short warm summers and longer cold winters. On the plains, average daily temperatures typically range between 5 to 10 (low) and 30 to 35 (high) degrees Fahrenheit in mid-winter and between 55 to 60 (low) and 85 to 90 (high) degrees Fahrenheit in mid-summer. The frost-free period (at 32 degrees Fahrenheit) generally occurs for 120 days between late May and mid-September. The annual average total precipitation is nearly 12 to 16 inches, with 36 to 60 inches of total annual snowfall. Temperatures will generally be cooler, frost-free periods shorter and both precipitation and snowfall greater at the higher elevations, including the mountains in the southwest portion of the Planning Area.

Prevailing surface winds occur from the southwest, but local wind conditions will reflect channeling (mountain and valley flows) due to complex terrain. Nighttime cooling will enhance stable air, inhibiting air pollutant mixing and enhancing transport along the valley drainages. Dispersion potential will improve along ridge and mountain tops, especially during winter-spring weather transition periods and summer convective heating periods.

Existing Air Quality

Although site-specific air quality monitoring is not conducted throughout most of the Planning Area, air quality conditions are generally good and well within existing air quality standards, as characterized by limited air pollution emission sources (few industrial facilities and residential emissions in the relatively small communities and isolated ranches). Existing air quality throughout most of the analysis area is in attainment with all ambient air quality standards, as demonstrated by the data presented in Table 3-1.

However, three areas have been designated as federal nonattainment areas where the applicable standards have been exceeded in the past: Lame Deer (PM_{10}—moderate) and Laurel (SO_2—primary), Montana; and Sheridan, Wyoming (PM_{10}—moderate). Anticipated existing contributors of pollutants within the region include the following:

- Emissions from conventional oil and gas developments, e.g., natural gas-fired compressor engines (primarily carbon monoxide [CO] and oxides of nitrogen [NO_x])

What has Changed in Chapter 3 Since the Draft SEIS?

Chapter 3 describes the affected environment. The BLM Planning Area did not change between the Draft and Final SEIS; it remains the Powder River and Billings RMP areas. Changes to this chapter include grammatical clarifications and additional information regarding air quality analyses, climate, black footed ferret release, wolfs and sage-grouse data that have become available since publication of the Draft SEIS.

- Coal mining activities (i.e., $PM_{2.5}$ and PM_{10})
- Coal-fired power plants (primarily NO_X, SO_2 and CO)
- Gasoline and diesel vehicle tailpipe emissions of combustion pollutants (volatile organic compounds [VOC], CO, NO_x, fine particulate matter less than 2.5 microns in effective diameter [$PM_{2.5}$], inhalable particulate matter less than 10 microns in effective diameter [PM_{10}] and sulfur dioxide [SO_2]).
- Dust (particulate matter) generated by vehicle travel on unpaved roads, windblown dust from neighboring areas, including tilled agricultural fields, construction activities and road sanding during the winter months.
- Transport of air pollutants from emission sources located outside the region.

As part of the Air Quality Impact Assessment – Technical Support Document (Argonne 2002) and during the Draft Task 1A Report for the Powder River Basin Coal Review Current Air Quality Conditions (ENSR July 2005a) monitoring data measured throughout southeastern Montana and northeastern Wyoming were assembled and reviewed. Although monitoring is primarily conducted in urban or industrial areas and may be relatively higher than expected in the rural areas of the state, the data is considered representative of existing background air pollutant concentrations throughout the Planning Area.

These values, presented in Table 3-1, reflect conditions where existing air pollutant sources (e.g., industrial sources, range fires, agricultural operations, etc.) may be impacting ambient air concentrations and so were deemed to be reasonable for use to define existing background conditions in the air quality impact analysis. Although deemed representative, background values were not inserted into the modeling results for this study (ENSR July 2005a) because the purpose of this effort was to model a baseline of current conditions and evaluate potential changes due to sources in the study area. Existing air quality conditions were developed from the State and Local Air Quality Monitoring System (SLAMS) database. The assumed background pollutant concentrations are below applicable National Ambient Air Quality Standards (NAAQS) and applicable Montana Ambient Air Quality Standards (MAAQS) and Wyoming Ambient Air Quality Standards (WAAQS) for all pollutants and averaging times, as shown in Table 3-1.

Additional Air Quality Modeling Studies

Two additional air quality modeling efforts have recently been conducted and can be reviewed to provide additional information on current regional air quality. These are the Wyoming Powder River Basin Coal Review modeling being conducted by the Wyoming BLM; and the MDEQ cumulative modeling prepared as part of the Badger Hills POD. These efforts were initiated in 2005 and 2004, respectively.

Wyoming Powder River Basin Coal Review Model

BLM identified a need to prepare a cumulative study of future development activities in the Powder River Basin (PRB) in northeastern Wyoming (the PRB Coal Review). The study area encompasses all of Campbell County, all of Johnson and Sheridan Counties (except land managed by the U.S. Department of Agriculture [USDA] Forest Service [USFS]) and a major portion of northern Converse County. A portion of the PRB in south central Montana is also included. It touches on portions of Rosebud, Custer, Powder River, Big Horn and Treasure counties.

The PRB Coal Review is an assessment of potential impacts on ambient air and air quality related values (AQRVs) associated with coal activities and future development using the CALPUFF modeling system. The project domain modeled includes most of Wyoming and portions of adjacent states (Montana, South Dakota and Nebraska). The domain refers to the area analyzed in the model.

Accurate, up-to-date (mid 2004) emissions inventories are not available; thus, for purposes of this study, "current" is defined as the most recent year, 2002, for which accurate emissions data are available. Some of the potential development included in the analysis for the 2003 Final EIS is no longer planned; therefore, the PRB Coal Review Study does not include such sources. The 2003 Final EIS suggested that impacts from coal development (including CBNG) could be substantial; indicating that there would be several additional days of haze in the region and that some thresholds might be exceeded. Therefore, the PRB Coal Review Study included modeling current (2002) emissions (modeled baseline) from all sources and comparing those results with current ambient monitoring data. Anticipated changes in emissions subsequent to a base year were modeled for the PRB Coal Review analysis.

TABLE 3-1

BACKGROUND CONCENTRATIONS OF REGULATED AIR POLLUTANTS ($\mu g/m^3$)

Pollutant	Averaging Time	Background Concentrations[1]		National Ambient Air Quality Standards	Montana Ambient Air Quality Standards[2]	Wyoming Ambient Air Quality Standards[2]
		MDEQ	WDEQ			
Carbon monoxide (CO)	8 hour	6,600	1,381	10,000	10,300	10,000
	1 hour	15,000	3,336	40,000	26,340	40,000
Nitrogen dioxide (NO_2)	Annual	11	5	100	94	100
	1 hour	117	-	n/a	564	n/a
Sulfur dioxide (SO_2)	Annual	16	13	80	53	60
	24 hour	89	62	365	260	260
	3 hour	325	181	1,300	n/a	1,300
	1 hour	666	-	n/a	1,300	n/a
Hydrogen Sulfide (H_2S)	1 hour	-	-	n/a	70	70[3]
Ozone (O_3)	8 hour	-	-	157	n/a	n/a
	1 hour[5]	-	-	235	200	n/a
$PM_{2.5}$	Annual	8	-	15	15	15
	24 hour	20	-	35	35	65
PM_{10}	Annual	30	13	Revoked[4]	50	50
	24 hour	105	54	150	150	150

Source: Argonne (2002), ENSR (2005), Wyoming DEQ (www.deq.state.wy.us/aqd/standards.asp), USEPA (www.epa.gov/air/criteria.html)

[1] Baekground numbers are from Montana DEQ (MDEQ 2002), Wyoming DEQ, Modeling protoeol (Argonne 2002 and ENSR 2005a)

[2]The Montana and Wyoming Ambient Air Quality Standards apply equally aeross their respeetive states. Conversions from state standards in ppm were ealculated using standard pressure (1 atmosphere) and temperature (298K).

[3]The 0.5-hour standard is not to be exeeeded more than twice per year.

[4]Due to a laek of evidence linking health problems to long-term exposure to coarse particle pollution, EPA revoked the annual PM_{10} standard in 2006 (effeetive December 17, 2006).

[5]The ozone 1-hour standard applies only to areas that were designated nonattainment when the ozone 8-hour standard was adopted in July 1997. The 1-hour standard does not apply to Wyoming.

$\mu g/m^3$ = mierograms per eubie meter

n/a = not applieable

PM_{10} fine partieulate matter less than 10 mierons in effective diameter

$PM_{2.5}$ fine partieulate matter less than 2.5 microns in effeetive diameter

This approach of comparing the modeled baseline with the study's findings provided a more accurate assessment of the sensitivity of the region to future development, as well as a qualitative measure of how well the CALPUFF model emulates near- and far-field transport of source emissions characteristic of those in the PRB.

The 2005 PRB Coal Review cumulative modeled air quality impacts for 2010 indicated that potential concentrations of all criteria pollutants would be below NAAQS and Montana and Wyoming AAQS, except near-field PM_{10}. Hazardous air pollutants (HAPs) would be lower than reference exposure levels and reference concentrations for chronic inhalation, except for benzene. Far-field visibility modeled impacts showed three Class I areas (Badlands National Park, Northern Cheyenne Reservation and Wind Cave National Park) with more than 200 days of greater than 1 deciview, increasing with development based the All Sources emissions group. Atmospheric deposition of the sulfur level of concern (LOC) was below the established threshold of 5 kilograms per hectare per year and atmospheric deposition of the nitrogen LOC was below the established threshold of 3 kilograms per hectare per year. In addition, atmospheric deposition effects on lake chemistry, as determined through modeled impacts on the acid neutralizing capacity, showed raised impacts above the level of acceptable impact for two lakes (Upper Frozen Lake in Bridger Wilderness Area and Florence Lake in Cloud Peak Wilderness Area). No significant impacts were predicted for the identified lakes.

The coal study also contained projected air quality impacts for 2015 and 2020. The impacts were evaluated qualitatively for those periods by using comparative development levels for each of the source groups. Coal production in general was anticipated to contribute substantially to impacts on the near-field receptor grid in the project area, particularly PM_{10} impacts. The potential PM_{10} impacts were of greatest

concern in the near-field and the projected increase in coal production likely would continue to affect the PM_{10} air quality levels. The 2010 modeling predicted potential exceedances of the 24-hour PM_{10} standard likely would be adversely affected by increased coal operations in 2015 and 2020. Increased development in 2015 and 2020 might lead to further visibility impacts at the Class I and identified Class II areas. In 2010, impacts on the non-affected lakes were well below the thresholds and expected increases in development likely would not lead to impacts beyond those noted in the model. The projected levels of increased coal production in 2015 and 2020 would not lead to a change in the impacts of HAP emissions for the near-field receptors in Montana or Wyoming. Furthermore, the qualitative results for 2015 and 2020 showed that no other NAAQS or state AAQS would be exceeded.

MDEQ Cumulative Model

The most recent cumulative impact modeling conducted by MDEQ was part of its review of the Badger Hills POD in 2004.

MDEQ conducted the recent cumulative impact modeling using EPA's approved Industrial Complex Short Term Version (ISCST3) model, Version 02035. This refined dispersion model uses detailed information regarding the region's meteorology, terrain and local emissions sources to estimate ambient air pollutant concentrations. The modeling analyses used the ISCST3 model in the regulatory default mode and EPA-approved modeling options.

Each emission source identified at all of the CBNG compressor stations was included in the air dispersion model as a point source. The model input data included stack exit height, temperature, velocity and stack diameter for each of the modeled emission sources. The permitted allowable emissions were used in the model for all Montana and Wyoming sources, rather than actual emissions. Typically, NAAQS/MAAQS demonstrations are conducted using permitted allowable emissions, whereas PSD increment analyses are conducted using actual emissions. Since all emission sources represented in this modeling study were permitted allowable emissions, the Class I/Class II increment analysis was conducted using permitted allowable emissions instead of actual emission estimates. Therefore, the Class I/Class II increment analysis results must be considered conservative, because not all emissions would be expected to operate continuously at maximum permitted levels.

This MDEQ cumulative modeling analysis demonstrated that CBNG development currently complies with the MAAQS/NAAQS and the PSD Class I/Class II increments. The peak modeled concentrations are located close to sources (John Coefield, personal communication, MDEQ 11/18/05).

Additionally MDEQ, EPA and the Northern Cheyenne Tribe are conducting a cumulative analysis of the Northern Cheyenne's Class I airshed increment. This study is intended to determine the definitive increment for the reservation for NO_X, SO_2 and PM_{10}. MDEQ anticipates this study will be completed by the end of summer 2008.

Existing Monitoring Network

MDEQ operates various types of equipment to measure pollutants and meteorological parameters at monitoring sites across Montana. Within the Planning Area, MDEQ presently maintains five monitoring facilities in the Billings metropolitan area and has additional, permit-required monitoring facilities in and around Colstrip. These additional facilities are operated by Pennsylvania Power and Light (PPL), formerly Montana Power Company (MPC). MPC/PPL also supports a tribal air monitoring program on the Northern Cheyenne Reservation.

Billings

The five monitoring stations currently operating in the Billings area are the Bridal Shop, Coburn Road, Lockwood Park, Lower Coburn Road and Mount Olive Stations. These monitoring stations conduct ambient sampling for various parameters and at various frequencies. Each is discussed below:

The Bridal Shop site has been collecting data since December 1997. It is a continuous (hourly) carbon monoxide (CO) monitoring site, but it has also previously collected meteorological (wind speed, wind direction and standard deviation of wind direction) data. The Aerometric Information Retrieval System (AIRS) reference number for this site is 30-111-0082. The Bridal Shop site is located at 8 Grand Avenue, Billings, Montana.

The Coburn Road site is a continuous (hourly) and 5-minute sulfur dioxide (SO_2) monitoring site. It has been collecting data since January 1981. It also collects meteorological data (wind speed, wind direction, standard deviation of wind direction and temperature). The AIRS reference number for this site is 30-111-0066. The Coburn Road site is located on Coburn Road south of Billings, Montana.

The Lockwood Park monitoring site has been collecting PM_{10} data since January 1996, $PM_{2.5}$ data since January 1999 and SO_2 and meteorological data since November 1987. The AIRS reference number for this site is 30-111-1065. The Lockwood Park site is located on Old Hardin Road, Billings, Montana.

The Lower Coburn Road site has been collecting data since August 1999. It is a continuous (hourly) and 5-minute SO_2 monitoring site. The AIRS reference number for Lower Coburn Road is 30-111-0083. The Lower Coburn Road site is located on Coburn Road south of Billings and north of the Coburn Road site.

The Mount Olive site is a continuous (hourly) CO and SO_2 monitoring site. The AIRS reference number for this site is 30-111-0079. The Mount Olive site is located at Mount Olive Lutheran Church, 7 24th Street West, Billings, Montana.

Particulate monitoring has been conducted in Billings since 1971. Although there have been several total suspended particulate (TSP) sites in Yellowstone County, only those in the central part of Billings recorded elevated concentrations. PM_{10} monitoring in Billings started in December 1986 and continues today at the Lockwood Park (30-111-1065) site. There has never been a recorded PM_{10} exceedance in Billings.

The sulfur dioxide issue in Billings has focused on emissions from industrial facilities since the early 1980s. The monitoring network was scaled down in 1996 when low sulfur coal was introduced and a dramatic drop in ambient levels was observed. Today, four of the five monitoring stations collect SO_2 data.

Billings is in an area where sources emit fairly large quantities of VOC and NO_x. Billings is also an area where hot summer days may promote photochemical reactions. EPA defines the ozone monitoring season for Montana as June 1 to September 30. Ozone data collected at monitoring sites showed higher concentrations in the summer months, but all were within the NAAQS. The ozone monitoring was discontinued in September 1989 because the readings were low. Since then, MDEQ has not conducted ozone monitoring.

Monitoring of CO is limited to two stations in the Billings area. NO_2 monitoring is not conducted at any of the stations.

Colstrip

The air quality concern for particulate in Roscbud County (population 9,383) centers around the cities of Colstrip and Ashland. Five coal-fired power generating plants and two large coal mines are near Colstrip. Montana Power Company, Western Energy Company, Colstrip Energy Limited Partnership (CELP) and Big Sky Coal Company have operated particulate sampling networks around their facilities as conditions of their permits. In Ashland, there have been recent concerns due to area sources, including wood- and coal-burning stoves.

MDEQ asked MPC/PPL to install and operate a PM_{10} site at its MPC Site 3 in Colstrip. Two samplers (reporting and collocated) were installed in December 1989 and the data were submitted to MDEQ. The TSP samplers at MPC Sites 1 and 2 were replaced with PM_{10} samplers in July 1992. At that time, MDEQ required MPC/PPL to operate the PM_{10} samplers at all sites on an every-third-day sampling schedule. In July 1994, MPC/PPL requested that MDEQ review its Colstrip PM_{10} network. As a result of that review, changes were allowed, starting on July 1, 1995. The PM_{10} sampling frequency at Site 1 was reduced to once every sixth day and the PM_{10} sampling at Site 2 was terminated. The long history of low values led to termination of Site 1 in 2002.

MPC/PPL maintains an ambient network around the facility and supports a tribal air monitoring program on the Northern Cheyenne Reservation. The tribal network consists of three sites: Morning Star, Garfield Peak and Badger Peak. MPC/PPL also operates three SO_2 sites. These are at MPC 1, MPC 2 and MPC 3. Years of data from the sites around the MPC/PPL facility revealed little to no accumulation and SO_2 monitoring at the facility was discontinued at the end of 2001.

MPC/PPL also maintained an ambient network for NO_2 around the facility through 2001. It continues to support a tribal air monitoring program on the Northern Cheyenne Reservation. Nearly 20 years of data collection around the facility revealed no significant NO_2 in the area. As a result of these findings, NO_2 monitoring around the MPC facility was terminated in 2001.

MDEQ conducted ozone monitoring in Colstrip from 1975 through 1977 at the BN monitoring site. MDEQ also conducted ozone monitoring in Colstrip at the McRae monitoring site in 1974 and 1975. Many exceedances of the NAAQS (1-hour concentrations) were recorded at the BN site, while no exceedances of the NAAQS or MAAQS were recorded at the McRae monitor.

Regulatory Framework

The NAAQS and MAAQS set the absolute upper limits for specific air pollutant concentrations at all locations where the public has access. The analysis of the proposed Alternatives must demonstrate continued compliance with all applicable local, state, tribal and federal air quality standards. Montana's ambient standards are not applicable within the reservation but apply to adjacent areas off the reservation. The EPA recently revised both the ozone (8-hour) and $PM_{2.5}$ NAAQS; these revised limits will not be effective until the Montana State Implementation Plan (SIP) is formally approved by EPA. On November 9, 2005, EPA issued a final rule to take the next steps to protect the American public from ground-level ozone pollution. This rule, often called the Phase 2 Ozone

Rule, describes the plans states must make to reduce ground level ozone. These plans, known as state implementation plans or SIPs, were to be submitted to EPA by June 2007.

Although EPA promulgated the NAAQS for $PM_{2.5}$ in July 1997, it lacked the necessary data to make designations. Therefore, the $PM_{2.5}$ designations were not finalized until April 5, 2005. The Clean Air Act requires states with designated nonattainment areas to develop a state implementation plan and submit it to the EPA within 3 years (April 2008).

Given that most of the Planning Area is in attainment with the NAAQS, future development projects (including any proposed Alternative) which have the potential to emit more than 250 tons per year of any criteria pollutant (or certain listed sources that have the potential to emit more than 100 tons per year) would be required to undergo a regulatory Prevention of Significant Deterioration (PSD) Increment Consumption analysis under the federal New Source Review and permitting regulations. Development projects subject to the PSD regulations must also demonstrate the use of Best Available Control Technology (BACT) and show that the combined impacts of all PSD sources will not exceed the allowable incremental air quality impacts for NO_2, SO_2 and PM_{10}. A regulatory PSD Increment Consumption analysis may be conducted as part of a major New Source Review, or independently. The determination of PSD increment consumption is a legal responsibility of the applicable air quality regulatory agencies, with EPA oversight. Finally, an analysis of cumulative impacts due to all existing sources and the permit applicant's sources, is also required during New Source Review to demonstrate that applicable ambient air quality standards will be met during the operational lifetime of the permit applicant's operations.

MDEQ requires that ambient air quality modeling be conducted for CBNG facilities that exceed the 25-ton-per-year Montana Air Quality Permit (MAQP) threshold, regardless of the potential to emit (PTE) of the facility. This is required to demonstrate compliance with the MAAQS/NAAQS. In addition, MDEQ requires that the modeling include an NO_X PSD increment analysis to demonstrate compliance with the Class I NO_X increment and the Class II NO_X increment, regardless of whether PSD applies to the facility.

The permit writer also provides a list of sources to be included in the modeling effort and recommends the appropriate near-field model to be used i.e. AERMOD, CALPUFF, SCREEN3. In addition an evaluation of cumulative effects is required.

MDEQ will continue to require MAQP applicants to model NO_X emitting units that locate in the area defined by the MT FEIS to ensure that the MAAQS and NAAQS, as well as the Class I and Class II NO_X PSD increments, are not exceeded. In addition, as CBNG development continues, or as CBNG facilities are proposed on properties closer to the Northern Cheyenne Indian Reservation, MDEQ intends to continue to require applicants to conduct NO_X PSD Class II increment analyses, as well as NO_X PSD Class I increment analyses. As CBNG development becomes more prevalent in Montana, MDEQ intends to require applicants conducting ambient air quality modeling for CBNG facilities to perform a cumulative impact modeling study. That is, MDEQ intends to require applicants conducting modeling for CBNG facilities to include the receptors that showed the highest impacts from previous models.

In 2005, MDEQ approved a new air permitting program that requires oil and gas facilities with a PTE greater than 25 tons per year to apply for an air permit before initiating operation of a new facility. The agency also initiated a new air registration program in 2006 to further regulate oil and gas activities across the state. Together, these new air permitting programs provide enforceable conditions that ensure both existing and future oil and gas activities are in compliance with state and federal regulatory requirements.

Mandatory federal Class I areas were designated by the U.S. Congress on August 7, 1977. These areas included wilderness areas greater than 5,000 acres in size and national parks greater than 6,000 acres in size on that date. In addition, the Fort Peck and Northern Cheyenne tribes have designated their lands as PSD Class I areas. The allowable incremental impacts for NO_2, SO_2 and PM_{10} within these PSD Class I areas are limited to ensure these areas remain pristine. In other locations of the country that are designated as PSD Class II areas, the requirements on future development are less stringent. Table 3-2 shows the relevant ambient air quality standards and PSD increment values.

This NEPA analysis compares potential air quality impacts from the proposed Alternatives to applicable ambient air quality standards and PSD increments. The comparisons to the PSD Class I and II increments are only intended to evaluate a threshold of concern for potential impacts and do not represent a regulatory PSD increment consumption analysis. Even though most of the development activities would occur within areas designated PSD Class II, the potential impacts on regional Class I areas are to be evaluated. MDEQ is responsible for performing any required regulatory PSD increment analysis as a part of the new source review process. The MDEQ's formal regulatory process would include an analysis of impacts on Class I and II air quality areas by emission sources following a triggered baseline date. Future development activities

are not allowed to consume more of the increment than is available within that PSD Class I or II area. To ensure compliance, stringent emission controls (BACT) and emission limits may be stipulated by state agencies in air quality permits as a result of their increment review. In more radical circumstances, a permit could be denied due to the lack of available increment.

In addition, sources subject to the PSD permit review procedure are required to demonstrate impacts on Air Quality Related Values (AQRV) will be below Federal Land Managers' "Limits of Acceptable Change." The AQRVs to be evaluated include potential reduction of the acid neutralizing capability in mountain lakes from atmospheric deposition (acid rain), visibility impacts and effects on sensitive flora and fauna in the Class I areas. The Clean Air Act (CAA) also provides specific visibility protection procedures for the mandatory federal Class I areas designated by the U.S. Congress. Although the Fort Peck and Northern Cheyenne Tribes have also designated their lands as voluntary PSD Class I areas, national visibility regulations do not apply in these areas. Finally, the CAA directs the EPA to promulgate the Tribal Authority Rule, establishing tribal jurisdiction over air emission sources on both trust and private lands within the exterior boundaries of tribal lands. Pursuant to this rule, Native American tribes may submit a "Treatment as a State" application to the EPA, requesting that they be treated in the same manner as a state under the CAA, including Section 105 grants and formal recognition as an affected "state" when permits are written for sources within 50 miles of tribal land boundaries (per 40 CFR 70.8 and 71.2). Also, the tribes can be delegated authority to establish an Operating Permits Program under Title V of the CAA, in order to issue permits for air pollutant major emission sources located within the exterior boundaries of tribal lands.

The Northern Cheyenne Tribe has held "Treatment as a State" status since 1999. Under EPA Program Section 105, the tribe conducts air quality monitoring for PM_{10} to support PSD increment studies. According to the MDEQ 2003 Air Monitoring Network Report (MDEQ AQ 2003) the MPC/PPL has been supporting the air quality monitoring on the Northern Cheyenne Reservation for a number of years. However, the Montana Power Company recently terminated its last PM_{10} monitoring site outside the coal fired power plants near Colstrip in 2002 due "to a long history of low values," as stated in the report.

TABLE 3-2

APPLICABLE AMBIENT AIR QUALITY STANDARDS AND PSD INCREMENT VALUES ($\mu g/m^3$)

Pollutant	Averaging Time [1]	National Primary	National Secondary	Montana	PSD Class I Increments	PSD Class II Increments
Carbon monoxide	8-hours	10,000	10,000	10,300	n/a	n/a
	1-hour	40,000	40,000	26,340	n/a	n/a
Nitrogen dioxide	Annual	100	100	94	2.5	25
	1-hour	n/a	n/a	564	n/a	n/a
Ozone	8-hours	157	157	n/a	n/a	n/a
	1-hour	235	235	200	n/a	n/a
Sulfur dioxide	Annual	80	n/a	53	2	20
	24-hours	365	n/a	260	5	91
	3-hours	n/a	1300	n/a	25	512
	1-hour	n/a	n/a	1300	n/a	n/a
$PM_{2.5}$	Annual	15	15	15	n/a	n/a
	24-hours	35	35	35	n/a	n/a
PM_{10}	Annual	revoked	50	50	4	17
	24-hours	150	150	150	8	30
Lead	Quarterly	1.5	1.5	1.5	n/a	n/a

Source: Argonne (2002).

[1] Annual standards are not to be exceeded; short-term standards are not to be exceeded more than once per year.

n/a = not applicable.

$\mu g/m^3$ = micrograms per cubic meter

Climate Change

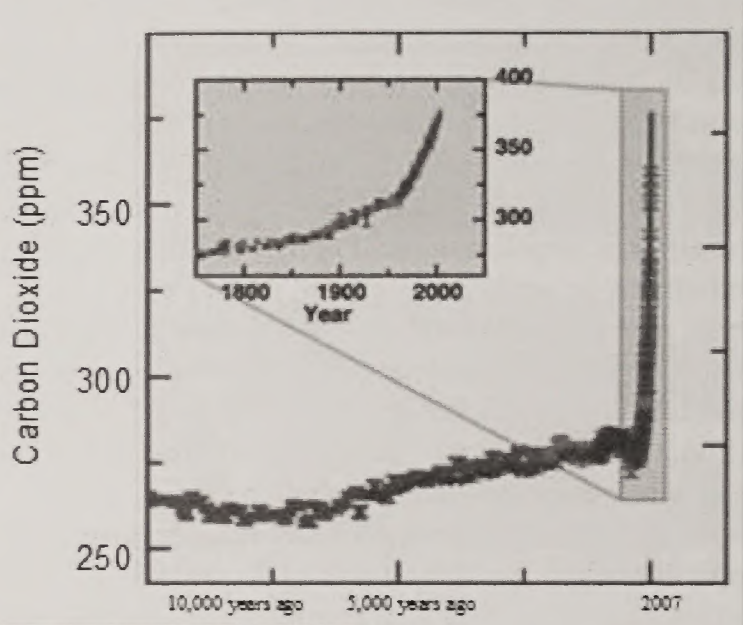
The National Academy of Sciences has noted that "Most scientists agree that the warming in recent decades has been caused primarily by human activities that have increased the amount of greenhouse gases in the atmosphere." The National Academy of Sciences has also indicated that "There is no doubt that climate will continue to change throughout the 21st century and beyond, but there are still important questions regarding how large and how fast these changes will be, and what effects they will have in different regions." (NAS, 2008). It has also been noted that "[a]s with any field of scientific study, there are uncertainties associated with the science of climate change. This does not imply that scientists do not have confidence in many aspects of climate science. Some aspects of the science are known with virtual certainty, because they are based on well-known physical laws and documented trends" (EPA, 2007a).

The primary gas associated with climate change is carbon dioxide (CO_2). Methane (CH_4), nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons are also associated with climate change. Together these gases are typically referred to as greenhouse gases (GHGs). Emissions of GHGs are typically reported as CO_2 equivalents (CO_2e), which is the amount of the gas emitted, multiplied by its warming potential relative to CO_2. Through complex interactions on a regional and global scale, these emissions cause a net warming effect of the atmosphere, primarily by decreasing the amount of heat energy radiated by the Earth back into space (NAS, 2008).

Although GHG levels and corresponding variations in climatic conditions have varied for millennia, recent industrialization and burning of fossil carbon sources have caused CO_2 concentrations in the atmosphere to increase dramatically, and these increases may contribute to overall climatic changes, typically referred to as global warming. Over the past three centuries the concentration of CO_2 has been increasing in the earth's atmosphere. In the early 1700s CO_2 concentrations have been estimated to be approximately 280 parts per million (ppm), while in 2005 the concentration was approximately 381 ppm (*See* Figure 3-CC-1) (Neftel et al., 1994; Keeling & Whorf, 2006).

The Center for Climate Strategies (CCS) prepared a report under contract to the Montana Department of Environment Quality (MDEQ) (CCS, 2007). The report contains an inventory of the State's GHG emissions. Activities in Montana accounted for approximately 36.8 million metric tons (MMT) of CO_2e emissions in 2005. This report also projects that in Montana there will be 38.5 MMT of CO_2e emitted in 2010, and 41.7 MMT of CO_2e emitted 2020. These figures are for the reference case scenario which "[a]ssumes very limited CBM activity" (CCS, 2007). Therefore, this scenario is comparable to that assumed for Alternative A (Existing Management).

Figure 3-CC-1: IPCC ESTIMATED CHANGE IN CO_2 OVER TIME



(Figure obtained from IPCC, 2007)

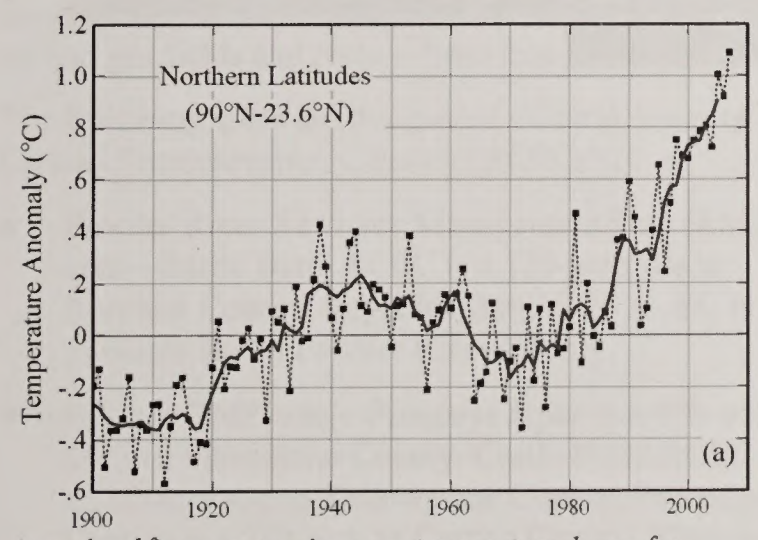
National and global carbon dioxide emissions for 2004 were tabulated by Energy Information Administration (EIA) in their Emissions of Greenhouse Gases Report (EIA, 2007). This information indicates that in 2005 there were approximately 7181 MMT of CO_2e emissions in the US. From the data in this report it can be extrapolated that U.S. CO_2e emissions in 2010 and 2020 will be approximately 7405 and 8275 MMT CO_2e respectively; assuming that the mix of GHGs remains constant. The data in this report can also be combined with data from the EPA (2006) for global non-CO_2 GHG emissions to estimate current and future CO_2e emission values. This analysis shows that in 2004 total global CO_2e emissions would have been approximately 36,510 MMT. It can also be projected that in 2010 global CO_2e emissions will be approximately 41,851 MMT, and in 2020 global CO_2e emissions will be approximately 49,750 MMT.

Human influences believed to have contributed to this rise include the combustion of fossil fuels, conversion of natural prairie to farmland, and deforestation (EPA, 2008a). In 2006 the primary GHG emitted by human activities in the U.S. was CO_2, representing approximately 84.8 percent of total GHG emissions, with the largest source of CO_2 being fossil fuel combustion. Conversely, U.S. GHG emissions are partly offset by carbon sequestration in forests, trees, in urban areas, and agricultural soils, which in aggregate, offset 12.5 percent of total emissions in 2006 (EPA 2008b).

Global mean surface temperatures have increased nearly 1.8°F (1.0°C) from 1890 to 2006 (Goddard Institute for Space Studies, 2008), but observations and predictive models indicate that average temperature changes are likely to be greatest in the Northern Hemisphere. Figure 3-CC-2 demonstrates that northern latitudes (above 24° N – which includes all of the United States) have exhibited temperature increases of over 2.3°F (1.3°C) since 1900, with approximately a 2.2°F (1.2°C) increase since 1970. Without additional meteorological monitoring systems, it is difficult to determine the spatial and temporal variability and change of climatic conditions, but increasing concentrations of GHG are likely to accelerate the rate of climate change.

The Intergovernmental Panel on Climate Change (IPCC) has recently completed a comprehensive report assessing the current state of knowledge on climate change, its potential impacts, and options for adaptation and mitigation (IPCC, 2007). The IPCC has reported that "[g]lobal mean surface temperatures have risen by 0.74°C ± 0.18°C [1.3± 0.3°F] when estimated by a linear trend over the last 100 years (1906–2005)". The IPCC has also determined that "most of the observed increase in globally average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic (man-made) greenhouse gas concentrations" (IPCC, 2007). The National Academy of Sciences (NAS, 2008) has also noted that "model simulations of temperature changes during the past century only match the observed temperature increase when greenhouse gas increases and other human causes are included".

Figure 3-CC-2: Annual Mean Temperature Change for Northern Latitudes



Annual and five-year running mean temperature change for northern latitudes. Uncertainty bars (95% confidence limits) are based on spatial sampling analysis. [This is an update of Figure 5 in Hansen et al. (1999).]
Source: Goddard Institute for Space Studies (2008)

The National Assessment Synthesis Team (NAST, 2000) has determined that "Across the Northern and Central Great Plains, temperatures have risen more than 2°F (1°C) in the past century, with increases up to 5.5°F (3°C) in parts of Montana, North Dakota, and South Dakota. In the southern Great Plains, the 20th century temperature record shows no trend. Over the last 100 years, annual precipitation has decreased by 10% in eastern Montana, North Dakota, eastern Wyoming, and Colorado. In the eastern portion of the Great Plains, precipitation has increased by more than 10%. Texas has experienced significantly more high intensity rainfall. The snow season ends earlier in the spring, reflecting the greater seasonal warming in winter and spring."

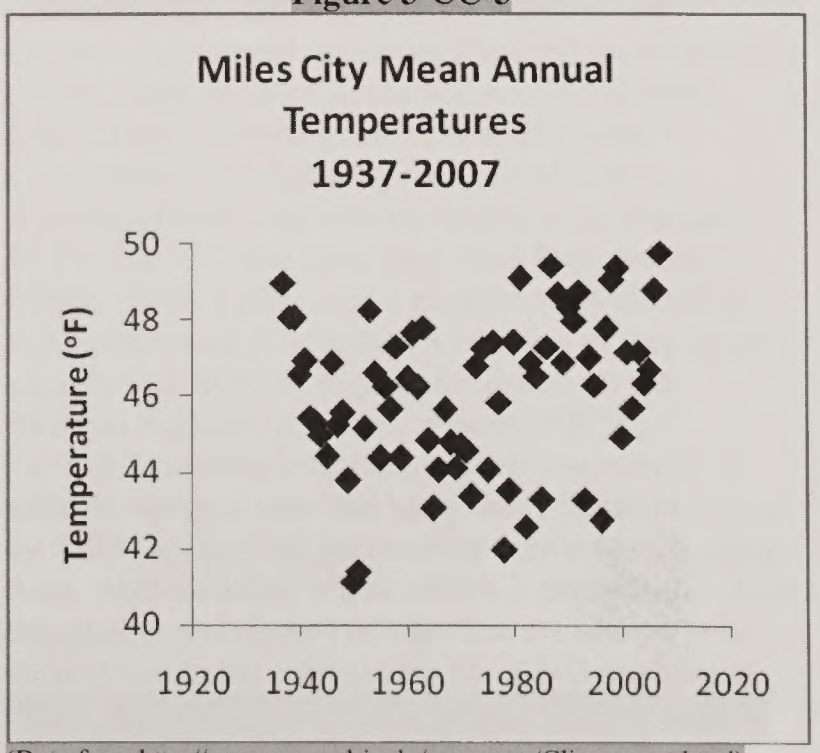
It is difficult to attribute any particular weather event to global climate change; however a comparison can be made between the anticipated impacts from global warming and recent observations. The EPA (2008a) has made several projections of cumulative effects for Region 8 (including the Planning Area) which can be compared to observed conditions. For this comparison the most recent 10 years is compared to the historical record for several parameters in order to evaluate recent trends relative to historic trends. These are discussed below.

Projection: *The region will experience warmer temperatures overall...*

Observed conditions:

Data from the Western Regional Climate Center (WRCC, 2008a) indicate that for the Miles City Airport the average annual temperature from 1937-1997 was 45.8°F (7.7°C). From 1998-2007 (the last 10 years of record) the average annual temperature has been 47.5°F (8.6°C), for an overall increase of 1.7°F (0.9°C). The five warmest years in the record (from warmest to coolest) are 2007, 1987, 1999, 1981, and 1998 (See Fig 3-CC-3). These results appear to be in line with the EPA (2008a) projection.

Figure 3-CC-3



(Data from http://www.wrcc.dri.edu/summary/Climsmemt.html)

Projection: *Temperatures are expected to increase more in the winter than in the summer...*

Observed conditions:

As discussed above, there has been an overall increase of 1.7°F (0.9°C) when average annual temperature records at Miles City from 1937-1997 are compared to 1998-2007. The monthly mean temperatures can also be grouped by season. For this analysis temperatures from December, January, February and March are considered "Winter" and temperatures from June, July, August and September are considered "Summer". Following this approach the mean winter temperature at Miles City from 1937-1997 was 23.1°F (-4.9°C), while the mean winter temperature from 1998-2007 was 27.0°F (-2.8°C). This represents a difference of 3.9°F (2.1°C). The mean summer temperature at Miles City from 1937-1997 was 68.3°F (20.2°C), while the mean summer temperature from 1998-2007 was 69.4°F (20.8°C). This represents a difference of 1.1°F (0.6°C). These results appear to be in line with the EPA (2008a) projection.

Projection: *The region will experience ... less snowfall.*

Observed conditions:

Snowfall records are not available from the WRCC for Miles City; however there is data from Burgess Junction, WY (in the Bighorn Mountains). While the values from this station are not directly applicable to the Powder River Basin, the trends should be meaningful, particularly since the Tongue and Powder Rivers obtain a significant portion of their flow from snowmelt in the Bighorn Mountains. Data from the WRCC (2008b) indicate that for Burgess Junction the average annual snowfall from 1960-1997 was 233 inches. From 1998-2007 the average annual snowfall was 255 inches. The five winters with the least snowfall (from least to most) were 1965-66, 1978-79, 1980-81, 1966-67, and 1968-69. These results do not support the EPA (2008a) projection.

Projection: *Earlier snowmelt means peak stream flows will be earlier...*

Observed conditions:

Average Mean Daily Discharge data from the Tongue River at Miles City can be compared from 1937-1997, and from 1998-2007. The average date of the peak stream flow from 1937-1997 occurred on May 28th. From 1998-2007 the average date of the peak stream occurred on June 3rd. Peak stream flows are thus occurring, on average, seven days later. This result does not support the EPA (2008a) projection.

Projection: *In late summer, rivers...will be drier.*

Observed conditions:

Minimum observed flows during August and September (late summer) can be compared from 1937-1997 and from 1998-2007. The average minimum late summer flow from 1937-1997 was 86 cfs. From 1998-2007 the average minimum late summer flow was 49 cfs. This represents a 37 cfs (43%) decrease in late summer flows. These results appear to be in line with the EPA (2008a) projection.

BLM recognizes the importance of climate change and the potential effects it may have on the natural environment. Several activities associated with the decisions in the MT SEIS/Proposed Amendments regarding CBNG development may generate emissions of climate changing pollutants. GHG emissions from CBNG development are anticipated to result from the burning of fossil fuels in compressor engines, and from methane emissions during processing. Wind erosion from disturbed areas and fugitive dust from roads along with entrained atmospheric dust have the potential to darken glacial surfaces and snow packs resulting in faster snowmelt.

Cultural and Historical

Cultural resources consist of the material remains of—or the locations of—past human activities, including traditional cultural properties (TCP) to both past and contemporary Native American Communities. Cultural resources within the Planning Area represent human occupation throughout two broad periods: the prehistoric and the historic. The prehistoric period is separated into the Paleo-Indian Period (circa 10,000 B.C. to 5,500 B.C.), the Archaic Period (circa 5,500 B.C. to A.D. 500), the Late Prehistoric Period (circa A.D. 500 to 1750) and the Proto-historic Period (circa 1750 to 1805+). The prehistoric period began with the arrival of humans to the area around 12,000 years ago and is generally considered to have ended in 1805 when the Lewis and Clark Expedition passed through the area. Cultural resources relating to the prehistoric period may consist of scatters of flaked and ground stone tools and debris, stone quarry locations, hearths and other camp debris, stone circles, wooden lodges and other evidence of domestic structures, occupied or utilized rock shelters and caves, game traps and kill sites and petroglyphs, pictographs, stone cairns and alignments and other features associated with past human activities. Some of these sites contain cultural resource features that are in buried deposits.

The historic period is characterized by the arrival of fur traders and explorers to the area and is the start of the period for which written records exist. Cultural resources within the Planning Area that are associated with the historic period consist of fur trading posts, homesteads, settlements, historic emigrant and stage trails, Indian war period battle sites, ranch development, railroad installations, mining operations, oil and gas fields and Native American sites.

The following areas are designated cultural Areas of Critical Environmental Concern (ACECs):

- Powder River Resource Management Plan (RMP) area—Battle Butte ACEC is a 120-acre site in Rosebud County. Reynolds Battlefield ACEC is a 336-acre site in Powder River County.
- Billings RMP area—Pompeys Pillar is a 470-acre site in Yellowstone County. Castle Butte ACEC is a 185-acre site in Yellowstone County. Petroglyph Canyon is a 240-acre in Carbon County. The Stark Site is an 800-acre site in western Musselshell County. Weatherman Draw is a 4,268-acre site in Carbon County.

Each of these ACECs has their own management plans that include restrictions on activities and development (BLM 1999a). Two additional cultural resource sites, the Mill Iron and Powers-Yonkee sites in the Powder River RMP area, have been designated Special Management Areas (SMAs) that also have their own management plans that include restrictions on activities and development.

TCPs in southeastern Montana that are currently important to Native Americans, include ceremonial, homestead, burial, cairn, rock art, fasting, medicine wheel, medicine lodges, settlements, stone rings, Sun Dance lodges, communal kills and battle/raiding sites as well as rivers, springs, spirit homes and vision quest spiritual locations and landscapes that include plant collecting areas, fossil and mineral locations, paint sources and water. For the Northern Cheyenne these include TCPs in or near Deer Medicine Rocks, Little Bighorn Battlefield, Medicine Rock Site, Chalk Buttes, locations in and around Custer National Forest and the Tongue River Valley. Detailed descriptions of these locations and their importance to the Northern Cheyenne can be found in the "The Northern Cheyenne Tribe and its Reservation" (Northern Cheyenne Tribe 2002). Crow TCPs include the west slopes of the Pryor Mountains, Tongue River Valley, Chalk Buttes, Broadus and Bighorn mountains (Crow Tribe 2002). Other TCPs exist in the Planning Area for tribes such as the Lower Brule Sioux and the Turtle Mountain Band of Chippewa, but they have not been specifically identified.

The existence of cultural resources within a specific location is determined through examination of existing records, on-the-ground surveys and subsurface testing of areas that are proposed for disturbance on federal, state and private lands. Cultural resources are evaluated if federal or state minerals are involved and, for traditional cultural properties, consultation with appointed tribal government representatives who have knowledge of and can address issues of traditional cultural significance. Section 106 of the National Historic Preservation Act (NHPA) requires an inventory of cultural resources if federal involvement is present either in terms of surface or mineral estate, federal funds, federal grant, or federal license. Consultation with federally recognized Native American tribes must also be conducted to evaluate TCPs. The Montana State Historical Preservation Officer (SHPO) maintains a register of all identified sites within each of Montana's counties as well as all sites that are listed or eligible for listing on the National Register of Historic Places (NRHP). Table 3-3 contains information about the number of cultural resource sites that have been identified to date by SHPO for each of the counties within the Planning Area. Also included in this exhibit is information about the number and density of sites that are known to be located within the current area of CBNG production. This table has been updated based on 67,158 acres of

TABLE 3-3

CULTURAL RESOURCE SITES IDENTIFIED BY SHPO WITHIN EACH COUNTY OF THE PLANNING AREA

RMP Area County	Number of Cultural Resource Sites Identified in Surveys	Number of Acres Surveyed	Number of Sites Per Surveyed 1,000 Acres	Acres Within the County	Percent of County Surveyed	Extrapolated Number of Sites In the County	Number of NRHP Sites Listed
Powder River RMP Area							
Carter	1,007	135,233	7.45	2,132,128	6.3	15,877	0
Powder River	1,807	94,468	19.13	2,109,880	4.5	40,358	1
Custer	812	44,346	18.31	2,425,137	1.8	44,406	15
Rosebud	1,689	200,413	8.43	3,213,997	6.2	27,086	16
Treasure	109	16,356	6.66	629,224	2.6	4,193	2
Subtotal	*5,424*	*490,816*	*11.05*	*10,510,366*	*4.7*	*131,920*	*34*
Billings RMP Area							
Wheatland	235	8,086	29.06	913,079	0.9	26,536	2
Sweet Grass	272	27,591	9.86	1,190,833	2.3	11,740	8
Stillwater	302	10,770	28.04	1,154,243	0.9	32,366	8
Carbon	1,367	41,469	32.96	1,319,367	3.1	43,492	64
Golden Valley	126	9,997	12.62	752,094	1.3	9,489	3
Musselshell	568	39,608	14.34	1,196,032	3.3	17,152	1
Yellowstone	918	48,087	19.09	1,693,991	2.8	32,339	22
Big Horn**	2,061	293,115	7.03	3,208,115	9.1	22,557	40
Subtotal	*5,849*	*478,723*	*12.22*	*11,427,754*	*4.2*	*195,671*	*148*
Total for SEIS Planning Area*	11,273	969,529	11.63	21,938,120	4.4	327,591	182
CBNG Area Above Known Coal Reserves			11.53	7,286,144		84,009	

* CBNG Production Area includes portions of Big Horn, Rosebud and Powder River counties where active coal mining is currently conducted and where federal and non-federal CBNG production wells currently exist.

**Also includes portion of Powder River RMP area.

Note: Information obtained from SHPO current as of November 2, 2004.

additional surveying done since the completion of the Statewide Document.

A complete listing of SHPO recorded sites can be found in "An Ethnographic Overview of Southeast Montana" (Peterson and Deaver 2002) along with a listing of sites mentioned in literary sources, potential homestead locations and spring locations.

The SEIS predicts 36,944 fewer cultural resource sites than the BLM 2003 Statewide Plan. This difference reflects improvements to eliminate duplication in the SHPO database and the exclusion of Blaine, Gallatin and Park counties from the SEIS planning area.

Approximately 4.4 percent of the SEIS Planning Area has been surveyed for cultural resources resulting in a total of 11,273 cultural resource properties or sites being identified. This represents an average density of 11.6 sites per 1,000 surveyed acres or, assuming an equal distribution of sites, one site per 86 surveyed acres. Assuming this data across the total acreage contained within the counties of the Planning Area yields a total of 327,591 cultural resource properties or sites that might be expected. A total of 3,744 sites have been identified in those portions of Big Horn, Rosebud and Powder River counties that represent the area with the greatest potential for CBNG production, with an average density of 11.5 sites per 1,000 surveyed acres or, assuming an equal distribution of sites, one site per 87 acres. Extrapolated data yields a total of 84,009 sites that might be expected within the CBNG production area.

The site densities estimated above are, of course, extrapolated assuming a consistent distribution within each county. This analysis is only valid for general site

number estimates and not for site location or type of site. Sites cluster based on a host of additional site location information such as geographical location, access to water, plant, animal and other resources, view and visibility, exposure, etc. The type of site is directly related to site location depending on the activity conducted at the site. Easily accessible geographical classification and other associated site data did not exist at the time this report was prepared and the estimates provided are the best that can be made at this time.

The data used for this analysis were based, in part, on surveys conducted more than 20 years ago and on recent surveys conducted for CBNG development projects. Standards for survey and recordation have changed and it is likely that the actual number of sites and their relative density is higher than indicated on Table 3-3. Despite these anticipated differences the general findings of this analysis are still valid.

Two reviews were prepared: the Class I Literature Review for the Miles City Field Office (MCFO) RMP Revision and the Landscape Level Overview for CBNG development areas in Montana. The Class I literature review for cultural resources was prepared to construct an overview of the cultural resources in the area. This document was prepared in concert with the State Historic Preservation Office to identify ongoing efforts and expand the knowledge of traditional uses within the Planning Area.

The Landscape Level Overview was prepared to provide a clear understanding of the cultural resources present within the CBNG development area and to identify any additional measures needed to protect these sites. A summary of the recent survey activity conducted for PODs is presented in Table 3-4.

Preservation projects within the Planning Area include the Rosebud Battle Field State Park Preservation Plan and the Tongue River Digital Archive Project (ACRS, 2006). Both projects were conducted by the Montana Preservation Alliance (MPA) through grants by the National Park Service.

The Rosebud Battlefield State Park Preservation Plan is being funded by the NPS American Battlefield Protection Program (ABPP) and is designed to create a broad and effective preservation plan to protect Rosebud Battlefield. MPA is working with Montana Fish, Wildlife and Parks (MFWP), leaders of tribes who share this history and other interested parties to produce a preservation plan for Rosebud Battlefield State Park and surrounding lands. The developers of the plan will strive to identify threats, lay out clear strategies for limiting the impacts of development and develop a design for long-term stewardship of the park's important historic and prehistoric cultural resources.

There are three existing National Historic Landmarks within the planning area. These include the Chief Plenty Coups Home, Pompey's Pillar and Pictograph Cave. Pictograph Cave and Chief Plenty Coups Home are state parks, while Pompey's Pillar is a National Monument/ACEC. Development is prohibited within state parks and National Monuments.

The Tongue River Digital Archive Project will create a digital archive of the rich cultural landscape that is the Tongue River Valley. The digital archive will integrate Native American and rural ranching traditions with rigorous historic sites recordation practices to create a lasting record of the history and cultural significance of valley resources.

The Tongue River Digital Archive project builds upon years of inquiry into the area's people, heritage resources and the land. MPA will visit historic places throughout the valley with Native American traditionalists and members of rural families to record important culture sites and stories. The information collected will be tagged to GIS cadastral maps, enabling photos and site forms to be called up from mapped points. The data will also be integrated into a statewide historic records database maintained by Montana's State Historic Preservation Office and the University of Montana.

TABLE 3-4

CULTURAL RESOURCE INVENTORIES FOR COAL BED NATURAL GAS and OTTER CREEK COAL TRACTS

Plan of Development (POD) Name	Sponsor	Cultural Resource Contractor	Total Acres	Acres BLM	Acres Private	Acres State	Total Sites	State Sites	Private Sites	BLM Sites	Previously. Recorded Sites – Not Relocated
Badger Hills	Fidelity E&P	Foothills Arch. Con[i]	604.0	0				Pre: 0 Hist: 0 Old: 0 New: 0 Isolates: 0	Pre: 0 Hist: 0 Old: 0 New: 0 Isolates: 1	Pre: 0 Hist: 0 Old: 0 New: 0 Isolates: 0	0
Badger Hills Infill	Fidelity E&P	Ethnoscience	3,544	123	2,810	611	18	Pre: 1 Hist: 0 Old: 0 New: 1 Isolates: 0	Pre: 12 Hist: 5 Old: 5 New: 12 Isolates: 2	Pre: 0 Hist: 0 Old: 0 New: 0 Isolates: 0	0
Coal Creek A	Powder River Gas	Western Land Services	736.40	0	736.40[ii]	0	3	Pre: 0 Hist: 0 New: 0 Old: 0 Isolates: 0	Pre: 2 Hist: 1 New: 3 Old: 0 Isolates: 6	Pre: 0 Hist: 0 New: 0 Old: 0 Isolates 0	0
Coal Creek 2	Powder River Gas	Western Land Services[iii]	1,720	160	1,560	0	22	Pre:0 Hist: 0 Old: 0 New: 0 Isolates: 0	Pre: 18 Hist: 3 New: 21 Old: 0 Isolates: 8	Pre: 1 Hist: 0 New: 1 Old: 0 Isolates: 1	0
Coal Creek South [viii]	Fidelity E&P	Ethnoscience Foothills Arch.	3,606[iv]	726.58	2,591.97	395.87	4	Pre: 1 Hist: 0 Old: 1 New: 0 Isolates: 0	Pre: 0 Hist: 2 Old: 1 New: 1 Isolates: 0	Pre: 0 Hist: 1 Old: 0 New: 0 Isolates: 0	1[v]
Coal Creek South -Infill	Fidelity E&P	Ethnoscience	4,943	1,292.0	3,375.0	276	4	Pre: 1 Hist: 0 Old: 0 New: 1 Isolates: 0	Pre: 1 Hist: 0 Old: 0 New: 1 Isolates: 1	Pre: 2 Hist: 0 Old: 0 New: 0 Isolates: 1	0
Dry Creek [vii]	Fidelity E&P	Ethnoscience	685.58	68	538.08	70	20	Pre: 2 Hist: 0 New: 0 Old: 2 Isolates: 0	Pre: 14 Hist: 1 New: 3 Old: 12 Isolates: 8	Pre:3 Hist: 0 New: 0 Old:3 Isolates: 0	0

TABLE 3-4

CULTURAL RESOURCE INVENTORIES FOR COAL BED NATURAL GAS and OTTER CREEK COAL TRACTS

Plan of Development (POD) Name	Sponsor	Cultural Resource Contractor	Total Acres	Acres BLM	Acres Private	Acres State	Total Sites	State Sites	Private Sites	BLM Sites	Previously. Recorded Sites – Not Relocated
Deer Creek North	Fidelity E&P	Ethnoscience	9,780.83	836.6	8,750.74	193.49	57	Pre: 2 Hist: 0 Old: 0 New: 2 Isolates: 0	Pre: 24 Hist: 29 Old: 17 New: 36 Isolates: 42	Pre: 2 Hist: 0 Old: 0 New: 2 Isolates: 1	5
Pond Creek	Fidelity E&P	Ethnoscience	9,945.77	911.03	8,394.74	640.0	147	Pre: 6 Hist: 0 Old: 1 New: 5 Isolates: 4	Pre: 111 Hist: 14 Old: 46 New: 86 Isolates: 56	Pre: 5 Hist: 0 Old: 0 New: 5 Isolates: 2	5
Deer Creek South (POD Not Yet Submitted)	Fidelity E&P	Ethnoscience	4,479	854	2,717	588	8(11)[VI]	Pre: 0 Hist: 0 Old: 0 New: 0 Isolates: 0	Pre: 4 Hist: 3 Old: 1 New: 6 Isolates: 7	Pre: 1 Hist: 0 Old: 1 New: 0 Isolates: 3	0
Dietz North-State Only [IX]	Pinnacle Gas Resources, Inc.	Western Land Services	640	0	0	640	11	Pre: 11 Hist. 0 Old: 0 New: 0 Isolates: 22	Pre: 0 Hist: 0 Old: 0 New: 0 Isolates: 0	Pre: 0 Hist: 0 Old: 0 New: 0 Isolates: 0	1
Totals			**37,115.18**	**4,903.29**	**28,797.53**	**3,414.36**	**294**	**25**	**255**	**14**	**12**

TABLE 3-4

CULTURAL RESOURCE INVENTORIES FOR COAL BED NATURAL GAS and OTTER CREEK COAL TRACTS

Plan of Development (POD) Name	Sponsor	Cultural Resource Contractor	Total Acres	Acres BLM	Acres Private	Acres State	Total Sites	State Sites	Private Sites	BLM Sites	Previously. Recorded Sites – Not Relocated
Pending CBNG Projects and Otter Creek Inventory											
Dietz South – POD and Reports Not Yet Submitted [x]	Pinnacle Gas Resources, Inc.	Western Land Services/Aaberg Cultural Resources Consulting Services-1999	5,040.00 (estimate)	1,160.00	3,880.00	0	18	Pre: 0 Hist.: 0 Old: 0 New: 0 Isolates: 0	Pre: 6 Hist.: 3 Old: 0 New: 9 Isolates: ?	Pre: 4 Hist.: 5 Old: 9 New: 0 Isolates: 1	0
Otter Creek Coal Tracts Inventory [xi]	State of Montana	GCM Services, Inc.	7,720.00	1,770.00	4,030.00	1,920.00	139	Pre: 22 Hist: 2 Old: 3 New: 21 Isolates: 19	Pre: 55 Hist. 7 Old: 22 New: 40 Isolates: 57	Pre: 37 Hist.: 0 Old: 14 New: 23 Isolates: 12	15
Sub-Total			**12,760**	**2,930**	**7,910**	**1,920**	**157**	**24**	**62**	**37**	**15**
Final Total			**49,875.18**	**7,833.29**	**36,707.53**	**5,334.36**	**451**	**49**	**317**	**51**	**27**

i Not Done as Block Inventory (10 acres – 40 acres around wells and 100 foot Aeeess Road/Infrastrueture Corridors)
ii Ineludes Multiple Reports 1 for block, 1 for inventory of site and 1 monitor
iii Draft Report Only
iv Ineludes multiple reports done in small blocks and eorridors
v Prehistorie Site On State Lands Not Relocated
vi 3 Sites reeorded as part of Deer Creek North POD
vii Based on 3 Reports
viii Partially overlaps with Deer Creek North POD
ix Ineludes 2 sites reeorded as part of Deer Creek North POD
x 580 aeres previously inventoried for Pennaco Prospeet in 1999
xi Some sites in this projeet are made of multiple previously reeorded sites

Geology and Minerals

Montana is the site of the juxtaposition of the Great Plains with the Rocky Mountains. The rocks at the surface vary from the ancient metamorphic and igneous complexes forming the cores of some mountains to recent sediments in the major river valleys of the state. The Geology of Montana plays an indispensable role in forming the mineral resources, visual resources and water resources of the state. The geologic history of the state has been a series of major structural events in the tectonics, or continent building of North America.

Map 3-1 is the Tectonic Element Map of the state of Montana. The map shows the locations of important basins such as the Bighorn and Williston that have trapped sediment containing coal, oil and natural gas. The map also locates mountain ranges such as the Crazy Mountains and Black Hills that served as sources for some of the sedimentary units. Several tectonic elements will be discussed in detail including those features that affect the state's resources – The Powder River Basin, The Bighorn Basin, Bighorn Mountains, the Bull Mountains Basin and others. These major tectonic elements influence the porous reservoirs that hold the usable water, oil and natural gas. They also influence the impermeable barriers to fluid movement. These elements influence the local folds and faults that form the oil and gas fields of the state.

Montana's basins have accumulated sediments several miles in thickness; these sands, shales, coals and limestones form the source and reservoirs of Montana's fossil energy reserves -- crude oil, natural gas, coal and coal bed natural gas (CBNG). In these basins, ancient sediments were buried to great depths within the earth where heating and increased pressure formed the fuels from the raw organic materials trapped in the sediments. The sedimentary basins also hold a significant portion of the water resources of the state; in the deep parts of these basins the water is generally salty while the shallower parts of these basins there is fresh water of meteoric origin.

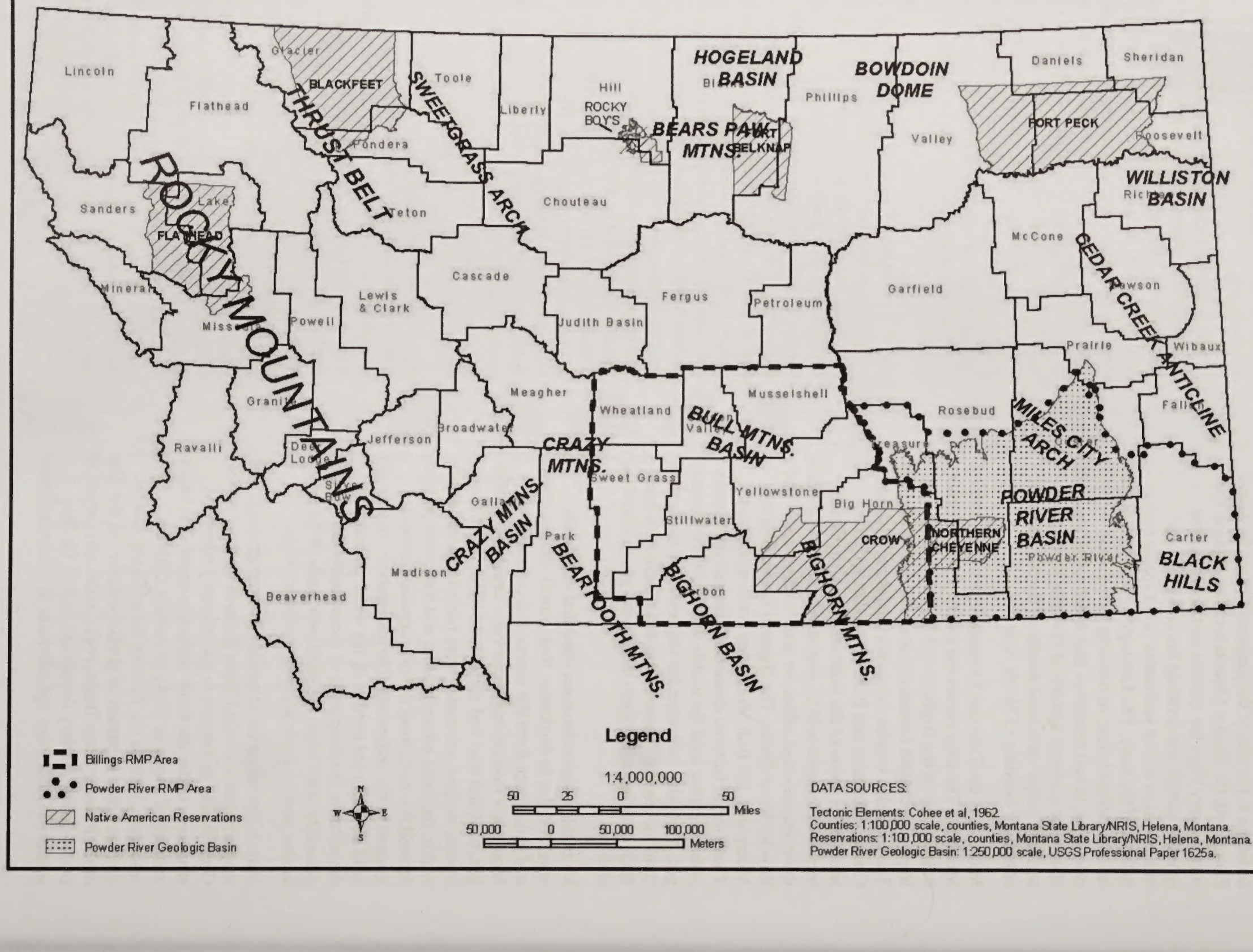
Map 3-2 presents the statewide outcrop geology. The map emphasizes broad basin features underlying the Great Plains in contrast to the intensely contorted structures under the many mountain areas. The basins mentioned above as likely to contain CBNG resources, such as the Powder River Basin, can be seen as broad expanses of similar outcrop. In the case of the Powder River Basin, rocks at the surface are all coal-bearing Tertiary formations except for the scattered Quaternary age alluvium in stream and river valleys. Other basins contain coal-bearing sediments of Cretaceous age. The presence of large volumes of suitable coal is vital for predicting CBNG development.

CBNG is the focus of this SEIS; it is important to recognize the resource is intimately associated with coal deposits. The natural gas is generated by the coal deposit both under thermogenic (heat-driven) and biogenic (microbe-driven) conditions. At the same time, the natural gas is trapped in the coal seams by the pressure of groundwater. Releasing the pressure of groundwater from the coal aquifers liberates the natural gas, allowing it to be produced and sold. The magnitude of the CBNG resource is determined by gas content, coal type and volume; the location of coal reserves can be used to predict the location of Montana's CBNG resources.

Map 3-3 is the statewide coal occurrence map. The map displays the extent of coal deposits that support mines and are expected to support projected CBNG development. The geology of Montana has given rise to several different kinds of coal; the most important differentiator is coal rank or thermal maturity. As coal is buried or otherwise heated, the raw plant material is gradually converted from complex carbon compounds to simple compounds and elemental carbon. Map 3-3 highlights coal rank or maturation ranging from lignite, sub-bituminous, high-volatile bituminous, medium-volatile bituminous, low-volatile bituminous and anthracite coals (Leythenhaeuser and Welte 1969). The major areas of interest are the Powder River Basin and Bull Mountain Basin, which contain mostly sub-bituminous coal that has not reached a high degree of maturation. Also of interest for CBNG is the Bighorn Basin which contains medium and high volatile bituminous coal of slightly higher maturity.

According to the Montana Board of Oil and Gas Conservation (MBOGC) records, CBNG has been produced only in the CX Ranch field in the Montana portion of the Powder River Basin since April 1999. Exploration solely for CBNG first happened in the Montana Powder River Basin in December 1990 in the area of CX Ranch. However, the first CBNG exploration in the state was in August 1990 in the Bighorn Basin where CBNG was tested but never sold. In many parts of the state, coals are aquifers that contain significant amounts of groundwater and are used by residents for water needs. In order to produce the CBNG in the Montana part of the Powder River Basin, groundwater must be drawn off the coal aquifer. Unless groundwater is produced from the coals, CBNG will not be produced; water production

Map 3-1: Tectonic Element Map of the State of Montana



Legend

- Billings RMP Area
- Powder River RMP Area
- Native American Reservations
- Powder River Geologic Basin

1:4,000,000

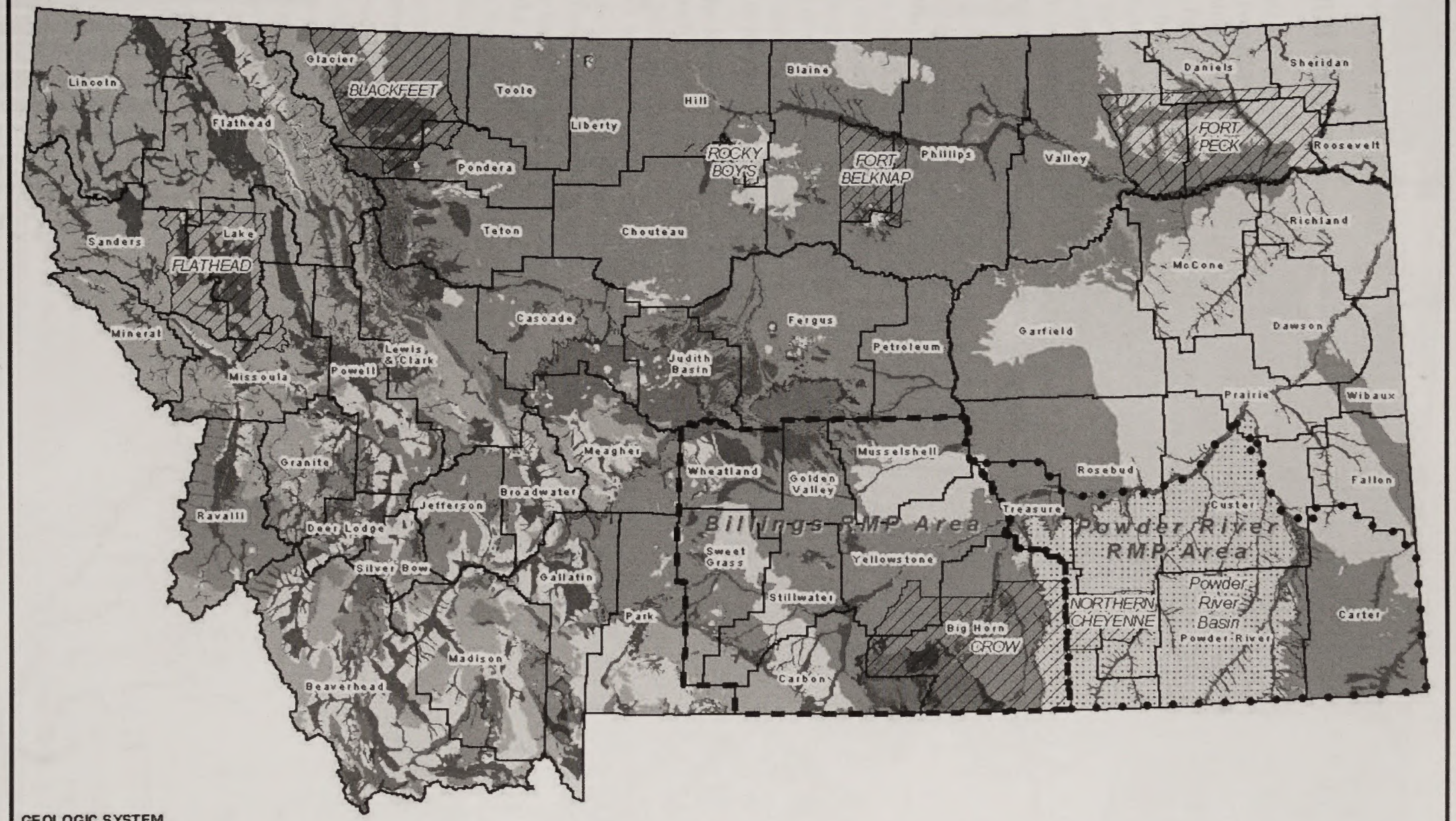
50 25 0 50 Miles

50,000 0 50,000 100,000 Meters

DATA SOURCES:

Tectonic Elements: Cohee et al, 1962.
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Powder River Geologic Basin: 1:250,000 scale, USGS Professional Paper 1625a.

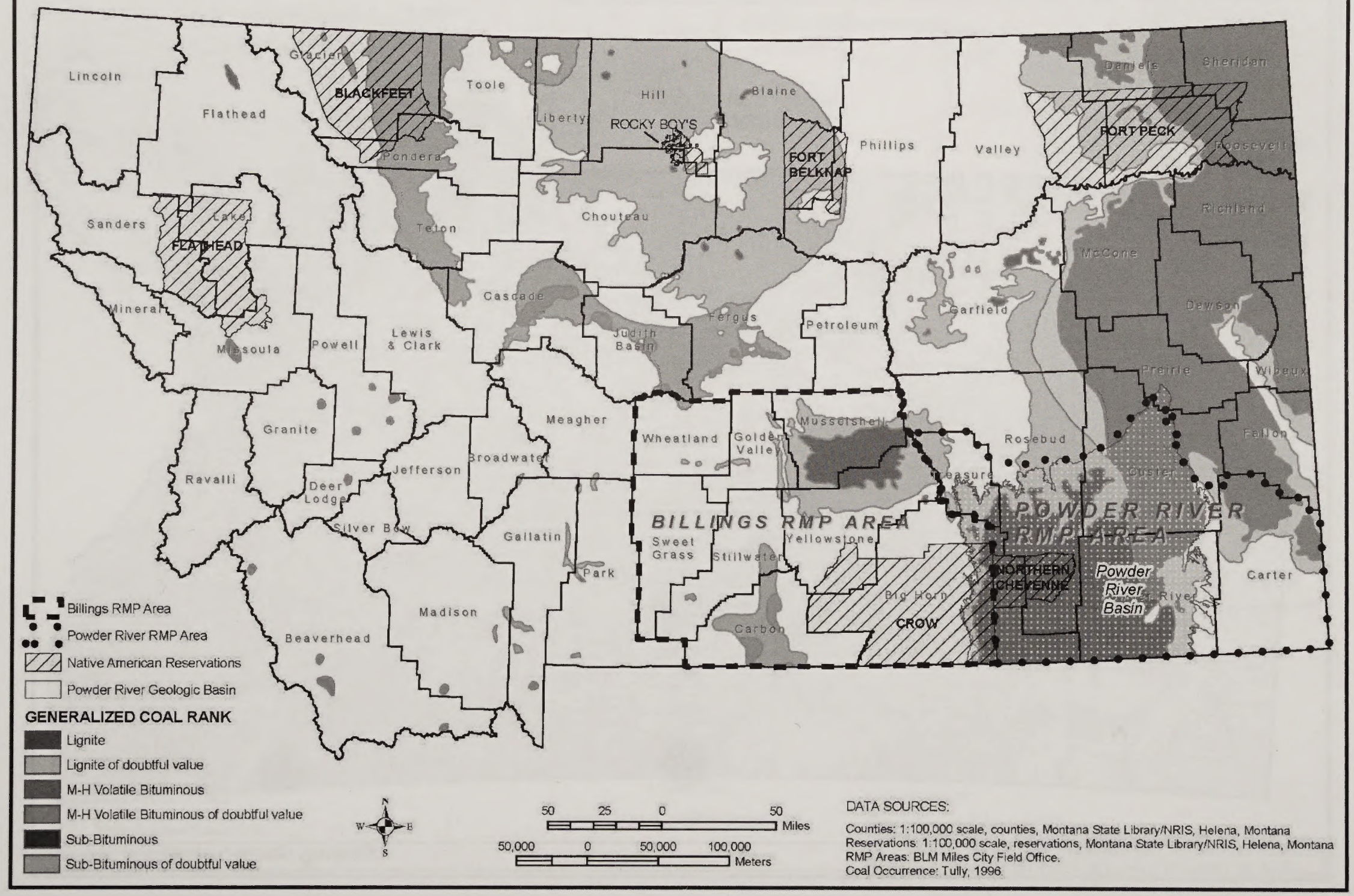
Map 3-2: Statewide Outcrop Geology



DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana
Geology: 1:1,000,000 scale, geology, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office

Map 3-3: Statewide Coal Occurrence Map



DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office.
Coal Occurrence: Tully, 1996.

cannot be avoided during CBNG development. This is the central conflict between CBNG and traditional uses of the land; when CBNG is produced, local coal aquifers must be depressurized. Depending on the area, this depressurization may extend beyond the CBNG producing field boundaries.

Regional Geology

The Planning Area of the SEIS consists of the Powder River RMP area and the Billings RMP area. The Planning Area contains three major basinal features – Powder River, Bighorn and Bull Mountains basins – and surrounding uplifted areas. All three basins were formerly broad shelves until Laramide tectonics caused uplift in the surrounding areas. This era of uplift and mountain building contributed to sedimentary deposition and subsidence within the basins during the Late Cretaceous and Early Tertiary. The Bull Mountains Basin and Powder River Basin were one continuous basin during the depositional periods of the Cretaceous and Early Tertiary. It was post-depositional tectonics that divided the two (Stricker, 1999). The asymmetric basins are the result of a combination of sedimentary and structural subsidence with most of the fill consisting of the Fort Union Formation. The Fort Union Formation also contains most of the coals occurring in these three basins.

The Powder River Basin in its entirety covers approximately 12,000 square miles with the smaller portion in Montana (Ellis et al., 1998). The Powder River Basin is bounded to the west by the Bighorn Uplift, to the southwest and south by the Casper Arch, Laramie Mountains and Hartville Uplift; and to the east by the Black Hills Uplift. The Miles City Arch and the Cedar Creek Anticline to the north essentially separate the Powder River Basin from the Williston Basin (ibid).

Coal has been mined in the Powder River Basin since 1865 and large-scale strip-mining has been underway since the mid-1960s when demand increased for relatively clean-burning coals (Flores and Bader 1999). Conventional oil and gas have been exploited in the Powder River Basin for more than 50 years while CBNG has been only lately developed with major activity beginning in 1997 (Rice et al. 2000).

Map 3-4 depicts the outcrop geology of the Montana portion of the Powder River Basin. The map illustrates the broad geometry of the basin with the youngest Tertiary strata (Wasatch Formation) preserved in the deepest part of the basin just north of the Wyoming-Montana state line. The broad bands of the Tongue River and Lebo/Tullock members throughout most of the basin attest to the shallow dips to the east and north edges of the basin. The narrow outcrop bands on the west limb of the basin indicate that the basin is somewhat asymmetrical with steeper dips on the western side.

Map 3-5 portrays the distribution of water wells, the prospective CBNG areas and existing CBNG production within the Montana portion of the Powder River Basin. The map was constructed from information in the MBMG Map 60 (Van Voast and Thale, 2001) and emphasizes those areas with thick, sub-bituminous and bituminous coal reserves. Coals are both water reservoirs and gas reservoirs and as such, CBNG production will affect local aquifers and even surface water. CBNG development is expected to be concentrated in the southern portion of the Powder River RMP area although coals exist over most of the basin and CBNG coverage could prove to be greater. The water wells shown in the map could be at risk to drawdown impact from CBNG development, especially those water wells completed in coal aquifers. Those aquifers at risk to CBNG impact are described in the Hydrology section.

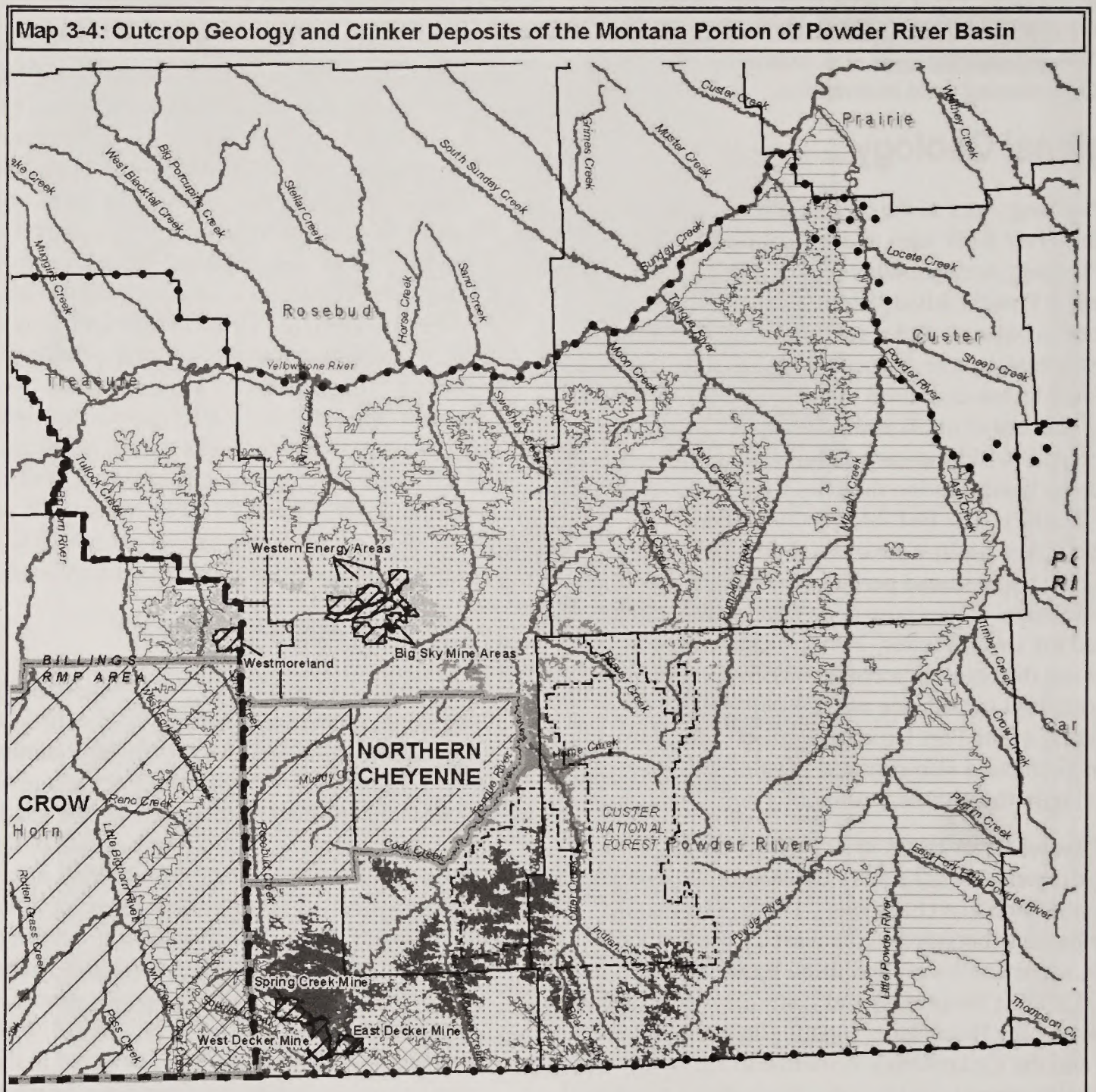
Stratigraphy

The stratigraphy of the Planning Area describes the age, composition and continuity of sedimentary rocks. The sedimentary strata of the Planning Area extend backward in time from Recent-age alluvium found in stream valleys, to strata at the surface that is largely Tertiary and Cretaceous. These older formations were deposited during the Laramide orogeny that gave rise to most of the uplifted areas in Montana. Though the area contains significant thicknesses of older formations, the Tertiary Age basin fills are of particular interest for coal, CBNG and groundwater production (Ellis et al. 1998). Conventional oil and natural gas occur in the older, pre-Laramide section but most coals of interest in the Powder River Basin are found in the Early Tertiary Age units. See Figure 3-1 for a stratigraphic interpretation of the regional geology of the Powder River Basin.

Figure 3-2 is a stratigraphic column of Upper Cretaceous and Lower Tertiary sediments in the Montana Powder River Basin. The stratigraphic column shows the continuous development of several thousand feet of sediments that include widespread sands, coals and fluvial, fine-grained sediments. The major formations are named along with major coal seams that are discussed in greater detail elsewhere.

Geologic formations found at the surface of the Powder River Basin consist largely of the several members of the Paleocene Fort Union Formation, as well as the overlying Wasatch Formation in a small corner of the basin (Rice et al. 2000). The Tongue River member of the Fort Union Formation contains

Map 3-4: Outcrop Geology and Clinker Deposits of the Montana Portion of Powder River Basin



Legend

- Powder River RMP Area
- Billings RMP Area
- National Forest
- Native American Reservations
- Coal Mines

Geology

- Wasatch Fm.
- Tongue River Mbr.
- Lebo/Tullock Mbr.

NORTHERN OUTCROP LIMIT OF COAL SEAMS WITH ASSOCIATED CLINKER

- Wyodak - Anderson Coal Clinker
- Knoblock Coal Clinker
- Colstrip Coalfield Clinker

1:1,300,000

20 10 0 20 Miles

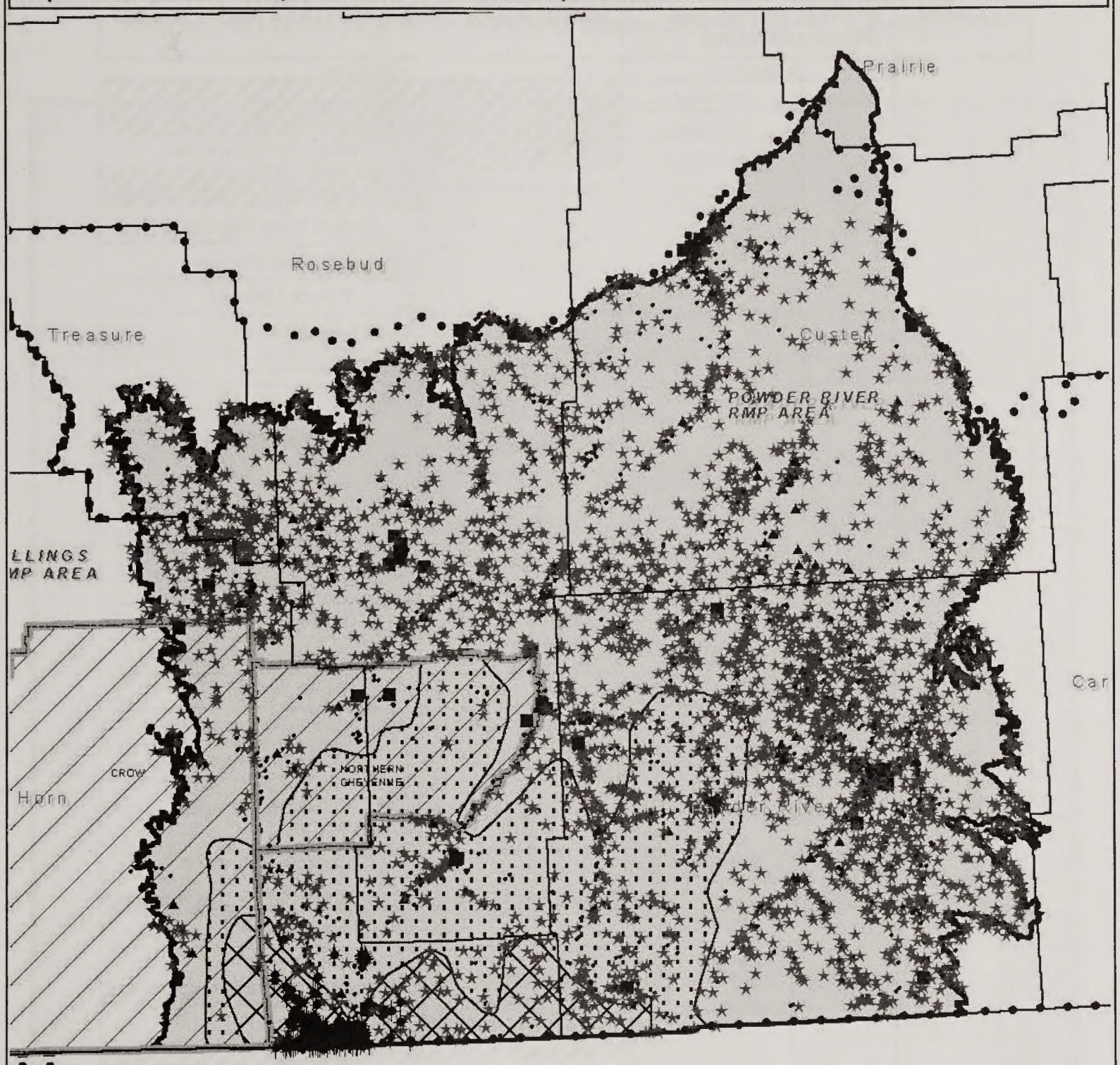
20,000 10,000 0 20,000 40,000 Meters

N W E S

DATA SOURCES

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Rivers: 1:100,000 scale, rivers, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office.
Geology and Coal: 1:250,000 scale, 1999, USGS Professional Paper 1625a
Coal Mine Boundaries: Montana Bureau of Mines & Geology

Map 3-5: Water Well Use, Current CBM Production, and CBM Likelihood in Powder River Basin



Powder River RMP Area
Billings RMP Area
Powder River Geologic Basin
Native American Reservations

WELL USE

- DOMESTIC
- IRRIGATION
- PUBLIC WATER SUPPLY
- STOCKWATER
- CBNG

POTENTIAL OF CBM DEVELOPMENT

- Higher
- Lower

Legend

1:1,300,000

20 10 0 20 Miles

20,000 10,000 0 20,000 40,000 Meters

N W E S

DATA SOURCES

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office.
Water Well Locations: Montana Bureau of Mines & Geology Water Well Database.
CBM Potential: 1:250,000 scale, Geologic Map 60, Montana Bureau of Mines & Geology.

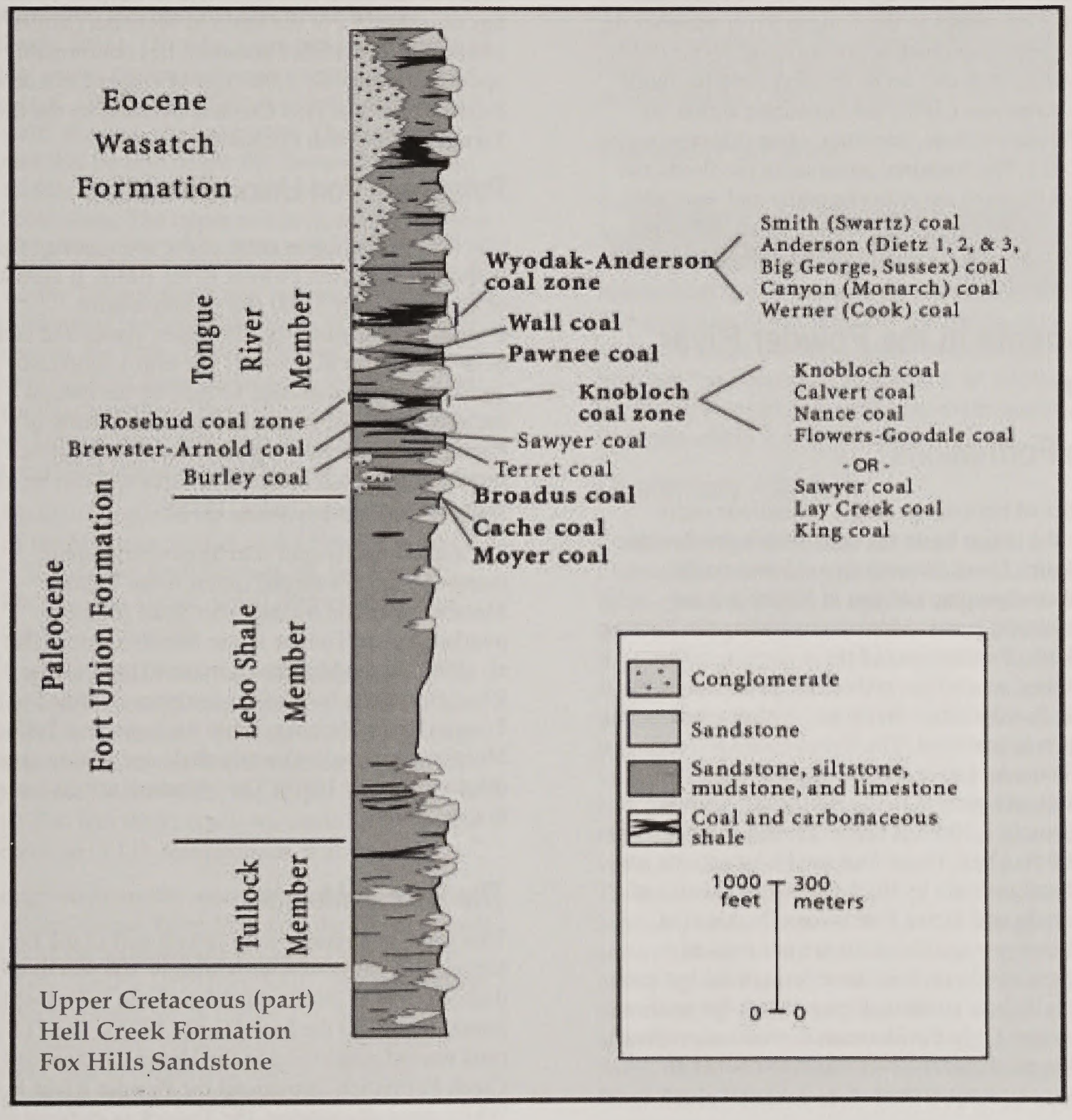
FIGURE 3-1 - STRATIGRAPHIC COLUMN OF THE TERIARY, MESOZOIC AND PART OF THE PAELOZOIC SEDIMENTS IN THE MONTANA AND WYOMING PORTIONS OF THE POWDER RIVER BASIN

The column includes formations that make up CBNG reservoirs and sources of water in the basin.

ERATHEM	SYSTEM, SERIES and OTHER DIVISIONS		POWDER RIVER BASIN, MONTANA AND WYOMING	
CENOZOIC	Quaternary		Alluvium	
	Tertiary	Pliocene		
		Miocene		
		Oligocene		White River Formation
		Eocene	Wasatch Formation	
		Paleocene	Fort Union Formation	Tongue River Member
				Lebo Shale Member
				Tullock Member
MESOZOIC	Cretaceous	Upper	Hell Creek Formation	
			Fox Hills Sandstone	
			Lewis Shale	Pierre Shale
			Judith River	
			Cody Shale	
				Niobrara Formation
			Frontier Formation	Carlile Shale
				Greenhorn Formation
				Belle Fourche Shale
			Mowry Shale	
		Lower	Muddy Sandstone	Newcastle Sandstone
			Thermopolis Shale	Skull Creek Shale
			Inyan Kara Group	Fall River Formation
				Lakota Formation
	Jurassic		Morrison Formation	
			Sundance Formation	Upper Part
				Lower Part
			Gypsum Spring Formation	
	Jurassic (?) or Triassic (?)		Chugwater Group or Formation	Spearfish Formation (Upper part)
	Triassic		Goose Egg Formation	Upper part
PALEOZOIC	Permian			(Lower part)
				Lower Part
				Minnekahta Limestone
				Opeche Formation
	Pennsylvanian		Tensleep Sandstone	Minnelusa Formation
			Amsden Formation	
	Mississippian		Madison Limestone	Madison Group

FIGURE 3-2 - STRATIGRAPHIC COLUMN OF UPPER CRETACEOUS AND LOWER TERTIARY SEDIMENTS IN THE POWDER RIVER BASIN

BEDROCK UNITS THAT FILL THE POWDER RIVER BASIN INCLUDE THE HELLCREEK, FORT UNION AND WASATCH FORMATIONS (MODIFIED FROM RICE ET AL. 2000).



the coal seams of interest within the Montana portion of the Powder River Basin. These coal seams function as the source of the CBNG, as well as aquifers carrying groundwater of varying quantity and quality. In the Powder River Basin coal seams range in depth from the surface to approximately 900 feet deep. Individual coal beds can be up to 50 feet thick and can form aggregate thicknesses over 100 feet. Coal seams in the Tongue River member do not have significant matrix porosity and permeability (Gray 1987); they can act as aquifers because fluids such as water and CBNG are contained within the coal's fracture system, known as cleat (Montgomery et al. 2001). The fractures accumulate the fluids and allow the fluids to move horizontally and vertically within the coal. Coals typically are bounded above and below by low permeability shale units (Wheaton and Donato, 2004).

Sediments in the Powder River Basin

Deep Formations

A number of regional geologic formations occur beneath the major basin fill units within the Powder River Basin. These formations as shown on the regional stratigraphic column in Figure 3-1 are broadly present across Montana including the Powder River Basin. Penetrations of these formations by conventional oil and gas wells have been few in the Montana Powder River Basin and hydrocarbon production is scattered. The Cretaceous age Judith River, Shannon, Eagle and Dakota/Lakota Formations are present in the subsurface between approximately 2,200 feet below ground surface (bgs) and 9,000 feet bgs. These four sandy formations are encased and overlain by thick Cretaceous shales of the Colorado and Pierre Formations (Noble et al, 1982). Reservoir quality sands are not present everywhere within each of these formations but each could locally be a suitable disposal zone for produced CBNG water. Only the Shannon Formation produces gas within the Powder River Basin (Nobel et al. 1982).

Upper Cretaceous Fox Hills and Hell Creek Formations

The Fox Hills Sandstone and Hell Creek Formations are Late Cretaceous in age and underlie the Fort Union in the Montana portion of the Powder River Basin. The formations are difficult to separate in outcrop and can be very difficult to separate in the subsurface, depending on the area and appear to be in hydrologic continuity. Together, the Hell Creek and Fox Hills total approximately 500 feet of non-marine coastal plain sediments that have been shed from the mountains to the east and west (Perry, 1962). They are made up of variable, shaley sands that contain some of the youngest dinosaur fossils in the world. The sands are scattered over most of Eastern Montana but are not present everywhere in the Powder River Basin; the formations crop out at the edges of the basin and are found as deep as 3,700 feet bgs near the axis of the basin in Montana (Miller 1981). The Fox Hills Formation lies conformably upon approximately 2,000 feet of Upper Cretaceous Pierre Shale. The Hell Creek is overlain by the thick Tertiary Fort Union Formation.

Paleocene Fort Union Formation

The Fort Union forms most of the sedimentary fill within the Montana Powder River Basin. It consists of approximately 3,500 feet of non-marine interbedded, sandstones, siltstones, shales and coal beds (Roberts et al, 1999a). The Fort Union also contains clinker deposits, formed by the natural burning of coal beds and the resultant baking or fusing of strata overlying the burning coal, which are present throughout much of the area and can be more than 125 feet thick (Tudor, 1975).

The Fort Union is split into three stratigraphic members: the lowest and oldest is the Tullock Member, overlain by the Lebo Shale Member, overlain by the Tongue River Member (McLellan et al. 1990). In the Montana portion of the Powder River Basin, the bulk of the coals are confined to the Tongue River Member, while the Lebo and Tullock Members are predominantly shale and shaley sand (McLellan et al. 1990). The Members are discussed in detail below:

The Tullock Member

This is the stratigraphically lowest part of the Fort Union, consisting of approximately 300 feet to more than 500 feet of interbedded sands and shales with minor coals near the base (Tudor 1975). The Tullock rests unconformably upon the Upper Cretaceous Hell Creek Formation throughout the Powder River Basin. While generally sandier, the Tullock is difficult to separate in outcrop and in the subsurface from the overlying Lebo Member. The Tullock and Lebo Members are combined into the Ludlow Member on the east side of the Powder River.

The Lebo Member

This middle member ranges from 75 feet to more than 200 feet of claystones, limestones and mudstones with the Big Dirty coal (3 to 13 feet of thickness) at the very base (Tudor 1975). The Lebo Member forms an effective barrier to vertical flow.

As such, any drawdown-related impacts associated with CBNG development in the Tongue River Member would be limited to that member.

The Tongue River Member

The thickness of the Tongue River Member varies from zero at the outcrop edge near the fringe of the basin to 3,000 feet near the axis of the basin (Williams 2001). The total aggregate thickness of all the coal seams ranges up to approximately 150 feet (Ellis et al. 1999b). The Tongue River Member can be locally divided into three units. The lower unit includes that portion below the Sawyer coal seam. The middle unit includes the Sawyer through the Wall coal seam. The upper unit includes that portion above the Wall coal seam (Ellis et al. 1999b).

The Lower Tongue River unit is present across most of the Montana portion of the basin. It includes, from the base up, the Stag, Terret, Witham, Robinson, Rosebud-McKay, Flowers-Goodale, Nance, Calvert and Knoblach coals. In the Ashland coalfield, the Lower Tongue River unit is up to 1,660 feet in thickness (Roberts et al. 1999b).

The Middle Tongue River unit is present over a large part of the Montana portion of the Powder River Basin. It includes, from the base up, the Sawyer, Mackin -Walker, Cache, Odell, Brewster-Arnold, Pawnee and Wall coals.

The Upper Tongue River unit is present only in the southern part of the Montana portion of the Powder River Basin. It includes, from the base up, the Otter, Cook, Carney, Canyon, Dietz anderson and Smith coals. At the Decker mine, the Upper Tongue River is up to 1,500 feet thick; coals can attain an aggregate thickness up to 111 feet (Roberts et al. 1999a).

Although coals are the most economically significant part of the Tongue River Member, they form a small portion of the sedimentary volume. They are also extremely variable stratigraphically, as shown in the cross-section depicted in Figure 3-3. Figure 3-3 shows stratigraphic variation of the Anderson-Canyon Coals in the area of the Decker Mine, Powder River Basin, Montana.

The cross-section illustrates the continuity or lack of continuity within the stratigraphic units. Coal aquifers can be seen to have local continuity but lack regional continuity. A local coal seam such as Dietz 1 can persist for several miles but the entire Anderson-Dietz package is eroded from the Colstrip area. The stratigraphic complications documented in Figure 3-2 suggest that even thinly separated coal seams may be very dissimilar. The cross-section illustrates the pinch-outs of coal seams, bifurcating coal seams and erosional cut-off of coal seams by Paleocene and Recent stream erosion. All of these factors can play a role in complicating the production of water and CBNG from the Fort Union Formation.

Fort Union coals are also present in the Bighorn Basin and the Bull Mountain Basin, where they are prospective for CBNG resources.

Wasatch Formation

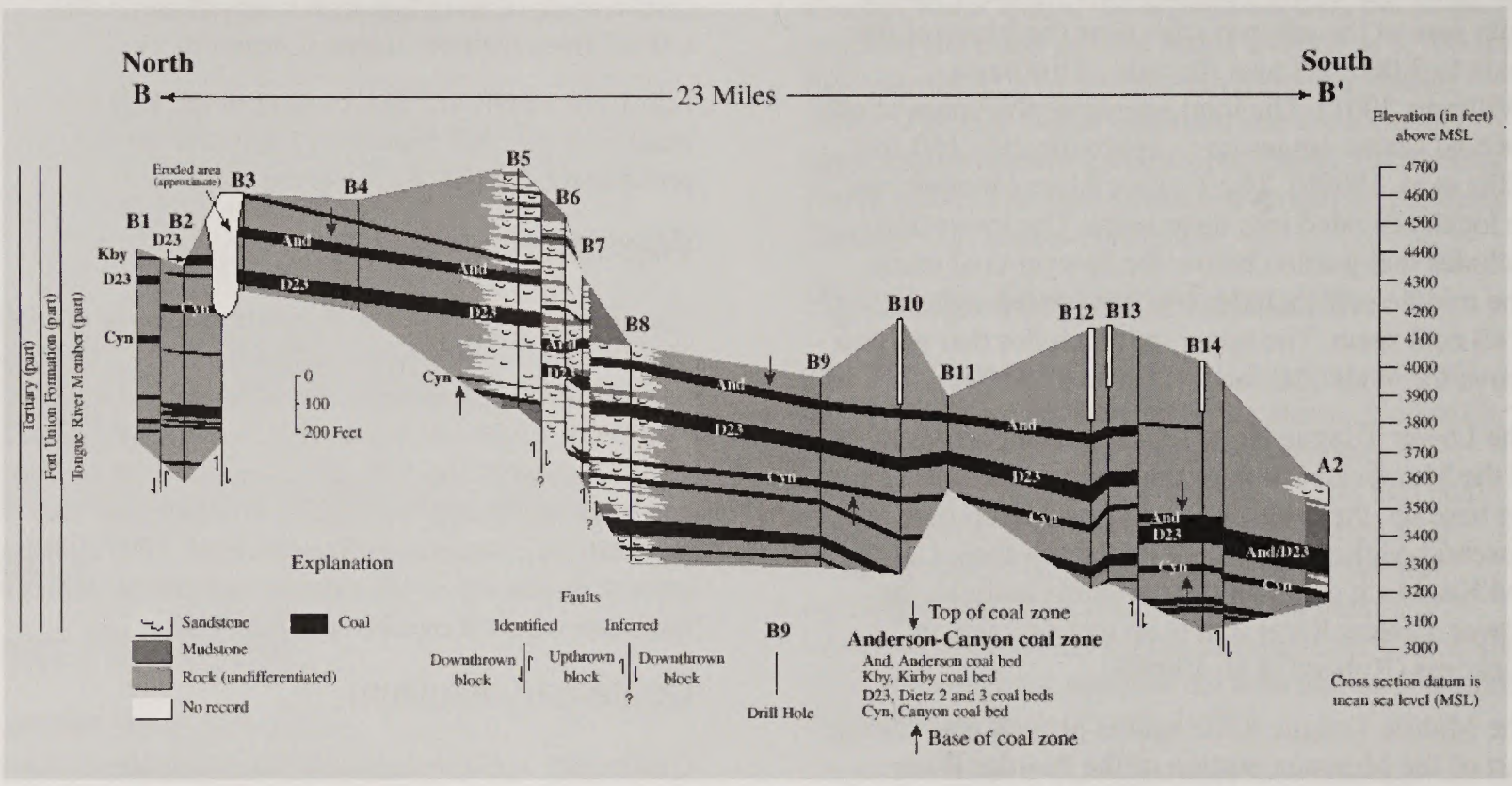
The Eocene Age Wasatch Formation is present in the Montana portion of the Powder River Basin as fine-to medium-grained sandstone lenses and channel-fill interbedded with siltstones, shales and minor coal. The thickness of the Wasatch Formation ranges from near zero at the outcrop edge to 400 feet near the southern state boundary (Roberts et al. 1999a). It is present in outcrop in the extreme southwest corner of the basin where it overlies the Fort Union.

Quaternary Alluvium

Quaternary age sediments are those that are Pleistocene (the latest glacial episode) and Recent (post-glacial episode) in age; the sequence is dominated by events and effects associated with continental glaciation, including glacial till and exaggerated peri-glacial valley fill. Quaternary sediments in the Powder River Basin and most of the state are present as variable fill in stream and river valleys. Quaternary alluvium consists of unconsolidated sand, silt and gravel that make up the floodplains and stream terraces of river and creek valleys in the Powder River Basin (BLM 1999b). Thickness is highly variable, but maximum thickness is not expected to exceed 90 feet. Lithology is somewhat dependent on bedrock outcrop; alluvium overlying the Tertiary strata are mostly fine-grained to medium-grained sands and silts. Coarser-grained alluvium may be associated with some of the larger rivers where provenance has been outside the Powder River Basin (Hodson et al. 1973). Alluvial aquifers are largely unconfined and connected to active river flow. Because alluvial aquifers can deliver large quantities of water to wells, they are important stratigraphic features. They are also important because they are vulnerable to impact from produced water management and are often connected to surface water resources.

FIGURE 3-3 - STRATIGRAPHIC VARIATION OF THE ANDERSON-CANYON COALS IN THE AREA OF THE DECKER MINE, POWDER RIVER BASIN, MONTANA (ROBERTS ET AL. 1999A)

CROSS-SECTION OF LOCALIZED STRATIGRAPHY OVER A SMALL PORTION OF THE POWDER RIVER BASIN NEAR DECKER, MONTANA.



Note: this cross-section reflects localized stratigraphy over a small portion of the Powder River Basin and is not intended to be a regional reflection of the entire Montana portion of the basin.

Powder River RMP Area

The Powder River RMP area is centered over the broad, flat-lying Powder River Basin, with basin margins rising up to the Black Hills (South Dakota) on the southeast and the Bighorn Mountains to the west. Oil production has occurred in The Powder River Basin since 1954. During 2004, 24 conventional oil and natural gas fields were active in the RMP area (MBOGC 2005). Production trends summarized in Figure MIN-1 of the Minerals Appendix (ALL 2001b) shows a sharp decline of oil production during the past 15 years caused by the aging of the several Muddy Formation fields on the edge of the basin. During the same time, conventional natural gas production from shallow Cretaceous reservoirs has increased, although it has remained at minor levels.

Billings RMP Area

The Billings RMP area centers on the Montana portion of the Bighorn Basin, the largest structural element in the area. The RMP area also includes the Big and Little Snowy and Little Belt mountains to the north that combine to make up the Central Montana Uplift. Oil and gas is produced from the Bighorn Basin and oil is also produced from the Central Montana Uplift. Natural gas and oil were produced from 55 fields in the year 2004. Production statistics for 2000 show a 50 percent decline of both natural gas and oil production in the past 15 years, although significant quantities of both commodities are still being produced in the area (ALL 2001b).

Conventional Oil and Gas

Conventional oil and gas resources are scattered across Tertiary and older basins of the state, as well as in faulted and thrusted sedimentary rocks at the edges of some of the basins. The type of hydrocarbon fluids that are produced (oil, natural gas, or both) varies with the local geology and position in the field. Natural gas can be produced along with oil in some reservoirs or it can be produced "dry"—without associated oil. Most oil and gas reservoirs will also produce associated water. Produced water is mostly injected under UIC permits, back into the producing formations to maintain reservoir energy or into non-productive, salt-water bearing reservoirs although there are currently 24 surface water discharge permits that have been issued for producing conventional oil and gas fields.

- The Williston Basin produces the majority of the oil for the state of Montana and small amounts of natural gas associated with the oil; except for shallow gas fields along the Cedar Creek Anticline, little dry gas is produced.
- North-central Montana produces mainly dry natural gas from shallow fields.
- Northwestern Montana produces shallow oil with little associated natural gas.
- Central Montana produces oil with virtually no natural gas.
- The Bighorn Basin produces small amounts of both oil and natural gas.
- The Powder River Basin produces small amounts of oil at the eastern edge of the basin and very small amounts of conventional natural gas from shallow reservoirs (MBOGC 2000).

Conventional oil and gas production for the RMP areas is summarized in the Minerals Appendix of this volume.

Coal Bed Natural Gas

CBNG is a naturally occurring resource becoming very important throughout the U.S. CBNG is natural gas that is generated during the geological process of converting plant material into coal through the action of burial and geothermal temperatures and during the natural process of biogenic transformation of organic matter into methane through the action of microbes in the coal. Several thousand CBNG wells have been completed in the Wyoming portion of the Powder River Basin while only approximately 950 CBNG wells exist in the Montana portion. CBNG is discussed in more detail in the Minerals Appendix of this volume and in the Water Resources Technical report (ALL 2001b) that includes numerous important references.

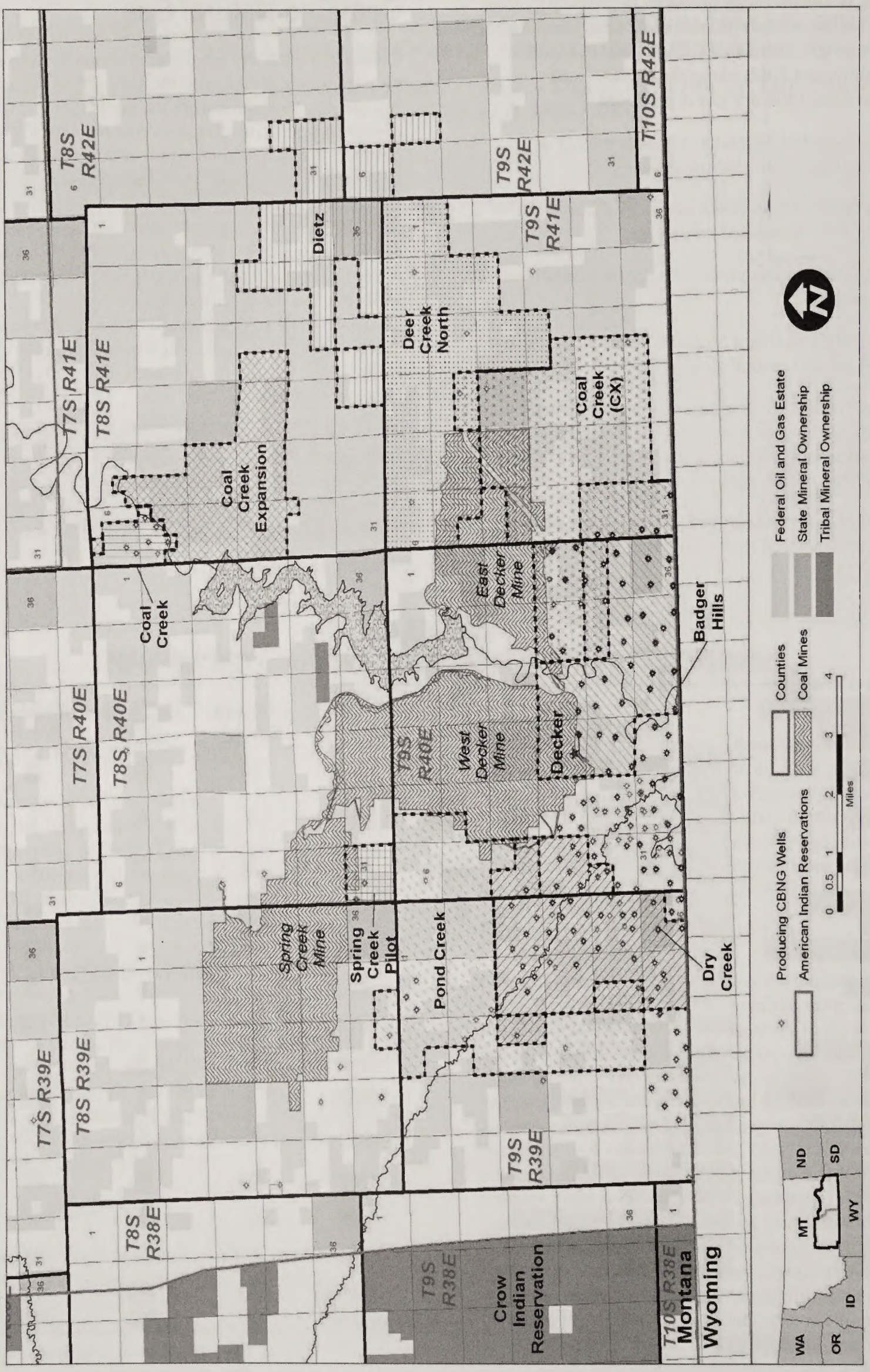
Table 3-5 contains the CBNG Plans of Development for Montana submitted since the ROD was signed in the spring of 2003. Figures 3-4 and 3-5 show the POD locations within the Upper and Lower Tongue Watersheds and the Middle Powder Watershed.

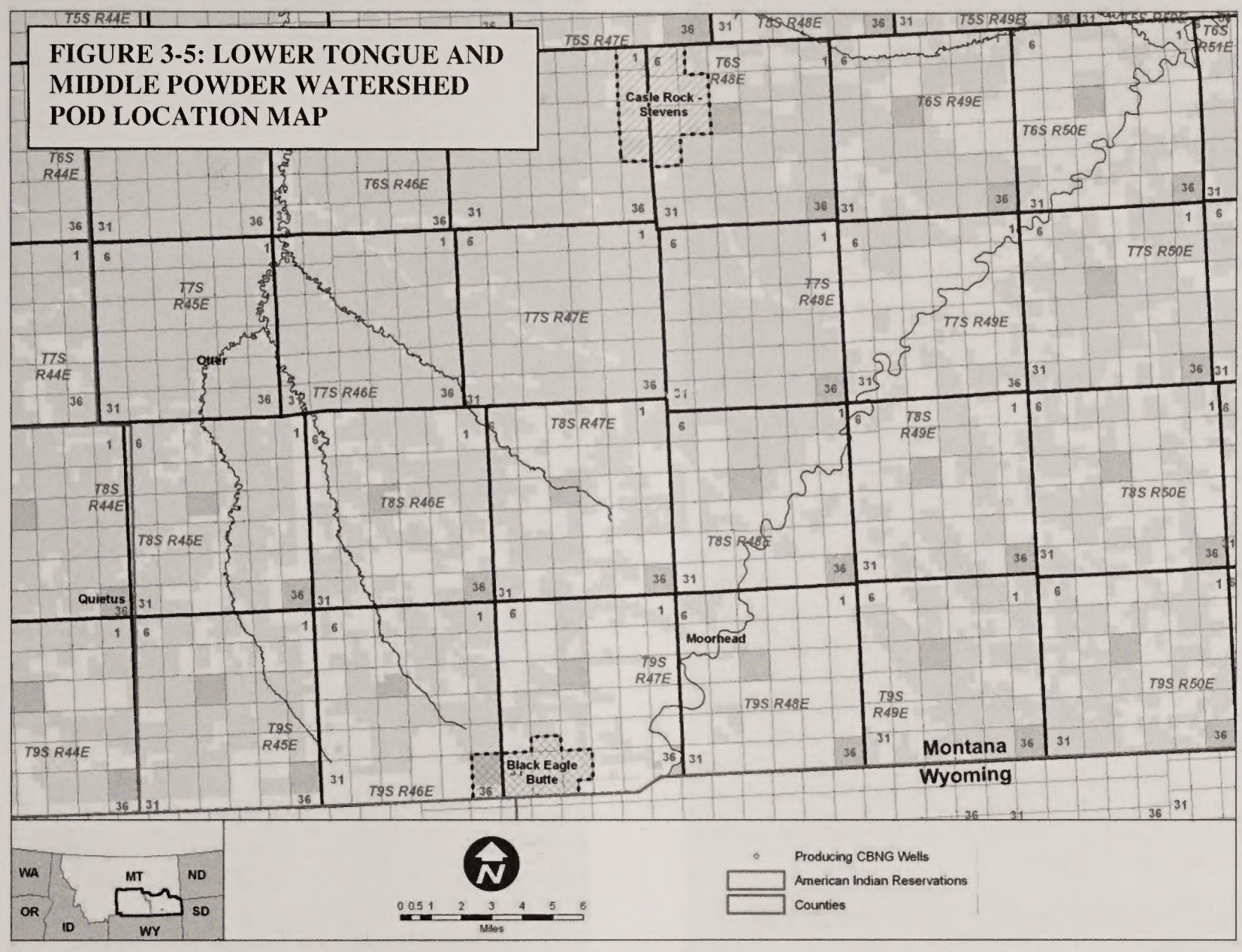
TABLE 3-5
CBNG PLAN OF DEVELOPMENT PROPOSED AND APPROVED APDS

Plan of Development (POD)	Company	Date Approved		Proposed Federal	Proposed State	Proposed Private	Total
		BLM	MBOGC				
Badger Hills	Fidelity Exploration & Production Co.	9/03-2/04	7/03	86	72	20	178
Coal Creek	Powder River Gas/Pinnacle Gas Resources, Inc.	11/04	11/04	8	0	8	16
Dry Creek	Fidelity Exploration & Production Co.	12/04	5/04	24	11	3	38
Coal Creek (CX) (Original)	Fidelity Exploration & Production Co.	1/05	2/05	132	16	62	210
Coal Creek Expansion	Pinnacle Gas Resources, Inc.		8/05	0	0	48	48
Pond Creek	Fidelity Exploration & Production Co.		9/05	55	0	23	78
Dietz	Pinnacle Gas Resources, Inc.		9/05	0	0	132	132
Deer Creek North (Original)	Fidelity Exploration & Production Co.		9/05	71	0	99	170
Castle Rock – Stevens	Powder River Gas, LLC		11/05	0	0	284	284
Deer Creek North POD Amendment	Fidelity Exploration & Production Co.		1/06	68	4	112	184
Coal Creek (CX) Amendment	Fidelity Exploration & Production Co.		3/06[1]	173	20	43	236
Black Eagle Butte	Pinnacle Gas Resources, Inc.		3/06	0	100	0	100
Badger Hills Amendment	Fidelity Exploration & Production Co.		6/06	36	29	38	103
			Totals:	**653**	**252**	**872**	**1,777**
		Total Approved		**250**	**252**	**872**	**1,374**

[1] Pending approval tentative date

FIGURE 3-4: UPPER TONGUE WATERSHED POD LOCATION MAP





Coal

Coal occurs in all of the RMP areas discussed in this SEIS (Roberts 1966 and Calvert 1912a and 1912b). Coal mining is underway at five mines in the Powder River RMP area and has historically been conducted in the Billings RMP area (USDL 1999). A more detailed description is included in the *Final Environmental Impact Statement, Resource Management Plan, Powder River Resource Area* (BLM 1984b). Coal resources are discussed in more detail in the Minerals Appendix of this volume.

Mineral Materials

Construction materials that are classified as saleable minerals are found in the RMP areas. These include sand and gravel, scoria, common clay and crushed common stone not subject to regulation under the 1872 Mining Law. Descriptions of these materials are given under Mineral Materials and Locatable Minerals in the *Final Oil and Gas RMP/EIS Amendment* (BLM 1992) and in the *Final Environmental Impact Statement, Resource Management Plan, Billings Resource Area* (BLM 1983) as well as the Final EIS Amendment for the Billings, Powder River and South Dakota Resource Management Plans of the Miles City District (BLM 1992).

Locatable Minerals

Locatable minerals are subject to provisions of the 1872 Mining Law. Minerals such as vanadium, uranium, gold, silver, gypsum and uncommon varieties of bentonite are found in the various Planning Areas. Detailed descriptions of management practices for locatable minerals on federally managed lands are given in the *Final RMP/EIS* for the Billings and Powder River Resource Management Plans of the Miles City District (BLM 1983, 1984b).

Geologic Hazards

Seismic activity, rock falls and abandoned mines are all geologic hazards that occur in the Planning Area. Rock falls are common in road cuts, stream cuts and cliff faces. Hazards are associated with abandoned

underground mines; these include adits and shafts, as well as subsidence holes over the mines. Landslides and avalanches can result from activities in surface mines; even small gravel pits can present a hazard.

Current management restricts activities in areas of known geologic hazards. Geologic hazard information is considered during the environmental analysis of individual proposals. When necessary, the MCFO develops appropriate mitigation measures.

The Surface Mining Control and Reclamation Act of 1977 provided the authority and funding to reclaim abandoned mines, as administered through MDEQ. Additional information on geologic hazards is generated through ongoing inventories conducted by the Montana Bureau of Mines and Geology and the MDEQ Abandoned Mine Lands Division.

Geologic hazards in eastern Montana consist primarily of threats from earthquakes; although even these are rare. Most strong earthquakes in Montana have occurred in the western third of the state. The only significant shock outside this area was an intensity VI earthquake on June 24, 1943, in southern Sheridan County, in the northeastern corner of the state. A well-constructed granary at Froid cracked so severely that wheat spilled out. Plaster cracks and minor chimney damage were reported at Homestead, Redstone and Reserve.

Methane Seepage, Migration and Venting

Methane seeps usually occur where coal beds are extremely close to the surface. Natural cracks or passageways for the gas to flow usually do not exist where the coal is deeper. The methane contained in Fort Union coals is present in a free state, adsorbed on interior pore surfaces and micropores of the coal matrix and dissolved in water contained within the coal seam.

Gas migration and seepage can be increased by coal mining or CBNG development. Reducing the hydrostatic pressure on the coal seam by pumping the water enhances the release of methane that was previously trapped in the coal matrix, as well as gas dissolved in the water. This free gas typically will flow towards the low pressure created by the pumping well. The objective is to extract the CBNG before it flows into areas of lower pressure.

Methane migration and seepage in the PRB have been associated with the escape of methane from coal mines located along the coal outcrops. Experience in the PRB has shown that seeps that involve potentially explosive concentrations of methane have occurred in coal seams near the surface. Escaping methane has created hazardous conditions. Examples are those documented in 1987, before CBNG development at the Rawhide Village subdivision 10 miles north of Gillette, Wyoming (Flores et al. 2001). The impacts of methane migration and concentration in a populated area can be serious. Rawhide Village was abandoned after explosive concentrations of methane were found to underlie the entire subdivision (Flores et al. 2001).

Methane seepage also can occur naturally in near-surface coal seams (Glass et al. 1987, Jones et al. 1987). The potential for methane migration within the PRB is not limited to areas that contain near-surface coal seams or areas where dewatering has occurred. Methane migration could occur at widespread locations within the PRB, as it can migrate long distances along joints or fractures in rocks. Gas generated in coal beds has also migrated into adjoining sandstone beds (Rice and Finn 1995).

Methane can escape due to inadequate well control procedures and faulty casing or plugging. Water wells frequently are screened over multiple aquifer zones, which would facilitate migration of methane through the well bore. Older, conventional oil and gas wells may not have had surface casing installed across all the coal seams, which could allow migration of methane from a lower seam to a formation that is closer to the surface. Conventional oil and gas wells could provide a conduit for methane migration if faulty cement was present behind casing or if the cement plugs placed in the well during abandonment developed a micro annulus. Numerous uncased boreholes were drilled in the PRB to evaluate the potential for uranium, as coal "strat" test wells or as monitoring wells. They were not properly plugged, which could allow methane, if present, to move through the formations penetrated.

Areas near coal outcrops and areas of coal or CBNG production where substantial dewatering has occurred or is occurring represent possible migration or seepage areas. Methane could emerge from water wells near CBNG production areas, affecting stock and residential wells. Other potential migration or seepage areas include areas with existing well bores and areas where faults, fractures, or sandstone layers occur in an orientation that provides a conduit for movement of methane. Methane hazard areas have not been mapped or compiled within the Planning Area. Furthermore, the integrity of existing wells within the Planning Area has not been comprehensively evaluated. No estimate of the total volume of seepage is available for the PRB.

Methane Seepage Study

Wyoming BLM has been conducting a methane seepage monitoring program for the past 5 years. The

study is being conducted out of the Buffalo Office by using soil-gas probes. The study was initiated by the Wyoming BLM state office and included installation of numerous soil-gas monitoring wells (each about 3 feet deep with a rubber septum on top) around the CBNG producing areas. BLM has gone back to these and newer wells several times to sample (pierce septum, evacuate well casing and replace septum,) and analyze the gas. The gas is analyzed for O_2, CO_2 and CO. Low values of O_2 and high values of CO_2 indicate seepage and oxidation of the gas. To date, this BLM study has not found indications of surface seepage. BLM continues to install these soil gas monitoring wells, but has observed no changes in gas content. They are currently proposing to put wells around the western side of the basin where shallow coals outcrop in clinker ridges. The Buffalo Office will be preparing a methane seepage report documenting the study and findings for release (personal communication, Dan Leeman, Mike McKinley and Ed Heffern, November 2005).

Comparison with Methane Migration and Seepage in the San Juan Basin

Methane migration and seepage associated with CBNG development in the San Juan Basin (SJB) of southwest Colorado are specific to local conditions in that area. Geologic conditions differ significantly between the PRB and the SJB. Most experience from the SJB is, therefore, not directly applicable to the PRB.

Basin pressurization and groundwater flow systems are not comparable between the two basins. The coals are found at a deeper depth and higher pressure in the SJB as compared to the PRB. The SJB is more deformed than the PRB and contains more faults and fractures that could serve as conduits for methane migration. In addition, coals are higher grade within the SJB, with a significantly higher gas content (400 scf/ton) and have cleats and fractures that are better developed than the lower-grade coals (25 to 100 scf/ton) within the PRB (GRI 2000). The PRB is not characterized by naturally occurring gas seeps, as is the SJB.

Naturally occurring gas seeps existed throughout the SJB before the earliest oil and gas drilling operations or CBNG development. Shallow water wells that penetrate coals in the SJB produced methane. Intensified seepage was reported as CBNG development progressed (BLM 2000c). Some residents noticed an apparent increase in the occurrence of methane in domestic wells as CBNG development progressed. Others noted the presence of gas seeps and dead vegetation in pastures. Stands of stressed and dying trees were discovered aligned with coal beds beneath the surface. Explosive accumulations of methane were discovered in wells and residences (BLM 2000c). As of early 2000, seepage was estimated (by a computer model) to have increased by at least 3 million cubic feet per day (MMcfd) and possibly by as much as 10 MMcfd over predevelopment levels (Questa 2000).

In the SJB, agencies recognized that older gas wells may have been acting as conduits for migration of gas into groundwater and implemented aggressive procedures to test existing wells, remediate problem wells and ensure that new and future wells could not act as conduits Colorado Oil & Gas Conservation Commission (COGCC 2000). Through May 2000, 269 repair procedures were completed on gas wells in La Plata County. The repairs were performed to eliminate the possibility that these wells would serve as conduits for migration of methane. Most of these repairs (except 36) were completed on conventional gas wells (COGCC 2000).

Reports of Montana Methane Seepage

Methane production from Montana wells has been an historical issue. In the 1970's, shallow wells drilled for coal exploration often produced methane (Wheaton, 2006). MBMG has compiled a list of monitoring wells impacted by methane production in the PRB. These include monitoring wells used by Spring Creek Coal Mine, Decker Coal Mine and MBMG. Most of the gas wells are located within areas depressurized by coal mines and CBNG production; however, some of the wells are located considerably outside areas of CBNG production and coal mining.

Reports of increased methane production led to plugging several water wells near the CX Ranch Field (Williams 2006). Montana Department of Fish, Wildlife and Parks reports increased methane production in two water wells on the Tongue River Reservoir State Park, as well as increased seepage under the reservoir.

Methane Seepage and the Use of Water Mitigation Agreements

Water mitigation agreements currently in use in the PRB were reviewed to evaluate their potential to alleviate the impacts of methane migration and seepage. Typical agreements indicated that all water wells within a specified vicinity (1 mile) and for which the agreement was enacted, would be sampled for gas content as a means of measuring change once CBNG operations were initiated. The agreements

define an impaired water well as one that experiences reduced capacity to deliver water in quantity and/or quality sufficient to support the ordinary and customary use of the well. In a discussion with Fidelity Exploration & Production Company, it was confirmed that the agreement would cover a well rendered unusable by methane migration (Williams, personal communication, March 2006).

The agreement states an affected well could be reconfigured, redrilled, or replaced; access to water could also be provided by other means as a method to offset such impairment. The agreement, however, did not necessarily indicate that anything would be done to mitigate or eliminate impacts related to methane gas creating either a safety or environmental hazard. Discussions with J.M. Huber Corporation (Huber) have revealed that it installs cisterns at local ranches where it suspects that the water wells might start venting natural gas. The cisterns function as de-gassing vessels that are open to the atmosphere and allow the natural gas to vent before the water is piped into the house or barn (DeLapp, personal communication, March 2006). Huber stated that it considers any water well with elevated natural gas as covered by its mitigation agreement.

Hydrological Resources

Hydrology within the Planning Area consists of surface water flow from several rivers and their associated tributaries and the production of groundwater from a variety of geological formations—the combination of which comprises the aquifer systems within any specific portion of the Planning Area. Of particular importance to residents is the protection of surface water and groundwater in the vicinity of CBNG development. CBNG development typically involves the necessary and unavoidable production of large volumes of water from coal aquifers and the appropriate use or disposal of this produced water. Continuous CBNG water production and disposal has the ability to impact both groundwater and surface water. As such, it is the subject of the Montana Department of Natural Resources and Conservation (DNRC) Final Order: In the Matter of the Designation of the Powder River Basin Controlled Groundwater Area. This order describes the authorities that pertain to CBNG development. A copy of the order is included as an appendix to the Water Resources Technical Report (ALL 2001b). The order outlines water rights issues, mitigation, monitoring plans and jurisdiction. Jurisdiction is summed up by this paragraph of the Order:

> "With this designation of a controlled groundwater area the withdrawal of groundwater associated with coal bed methane production will be under the prior jurisdiction of the Montana Board of Oil and Gas. However, water rights matters and hydrogeologic issues are not within the ordinary technical expertise and area of concern to the Board. These are matters ordinarily dealt with by the Montana Department of Natural Resources and Conservation and the Montana Bureau of Mines and Geology.
>
> The Montana Department of Natural Resources may petition the Board for hearings in regard to the production, use and disposal of water from coal bed methane development wells that could affect existing water rights in the area based upon information gathered concerning water withdrawals."

Protection of groundwater will focus on maintaining beneficial uses. The coal seams are the primary aquifers for the agricultural community in southeastern Montana. In many areas, the coal aquifers supply water for livestock, wildlife and domestic use. In the Bull Mountain coalfield, the coal seams are also used as aquifers, though to a lesser degree than in southeastern Montana. In other coal bearing areas of the state, coal seams are not used as aquifers, or that use is limited and not well documented.

Surface Water

Surface water is the primary source of water for all uses in Montana, representing 97 percent of the water used throughout the state (Solley et al. 1995). The quality of groundwater from near-surface aquifers within the west half of the Billings RMP area is usually very good. Maps 3-6 and 3-7 show the occurrence of surficial aquifers as well as the quality of the groundwater produced from these aquifers.

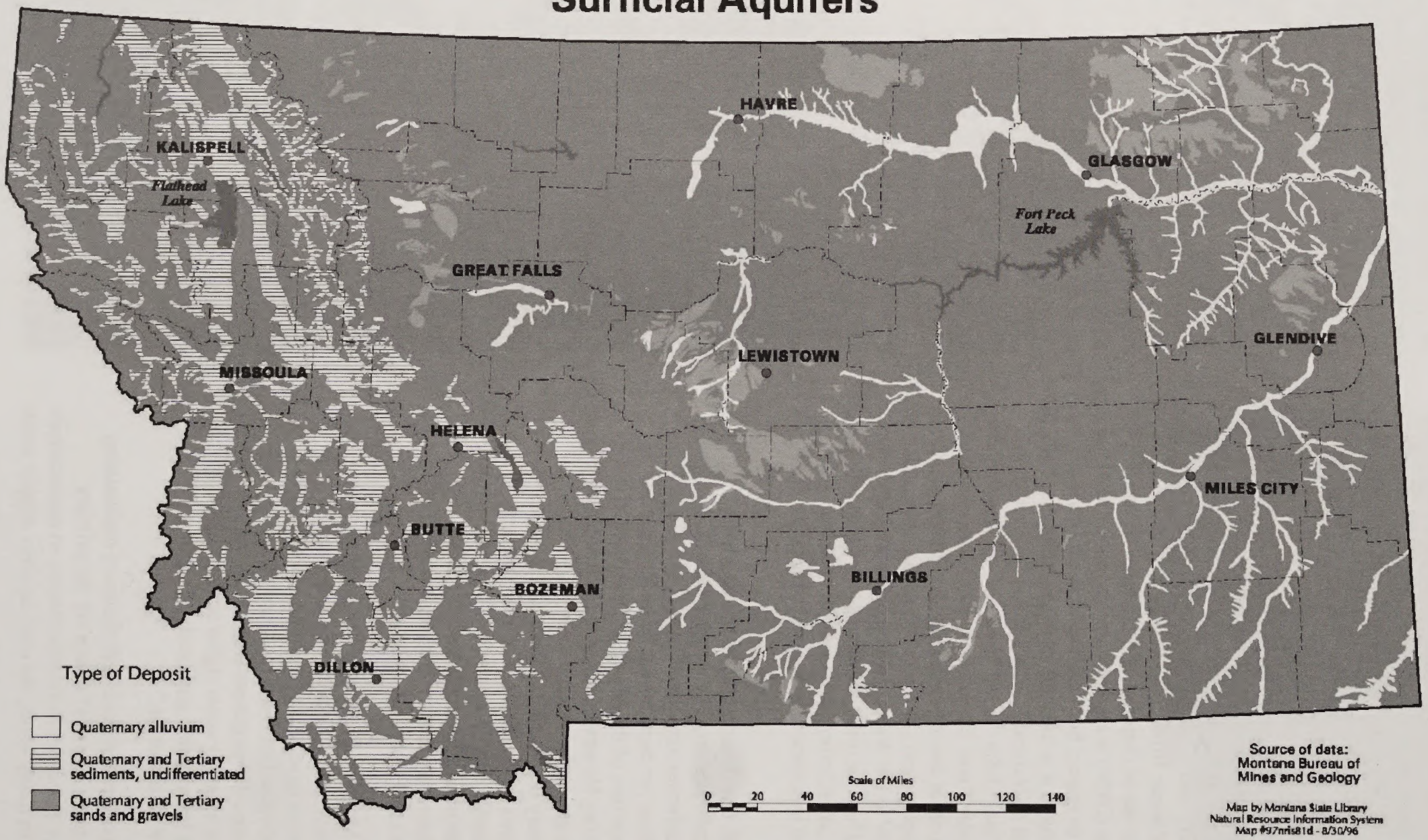
Map 3-8 shows PRB fourth order watersheds and the locations of selected USGS monitoring stations. The map emphasizes those watersheds most likely to experience CBNG development. The volume and quality of surface water can best be interpreted on a watershed basis.

Electrical conductivity (EC) and sodium adsorption ratio (SAR) are the primary constituents of concern with CBNG discharges (MDEQ 2003); therefore, the surface water analysis in this document will focus on these parameters. EC is the ease with which electric current will pass through a water sample and it is proportional to the salinity of the sample. The units used for EC of a water sample are microSiemens per centimeter (μS/cm). SAR is a complex ratio of sodium to calcium and magnesium and it is an important parameter for determining the utility of water for irrigation due to the potential impacts of sodium on clay rich soils. Since SAR is a ratio, it is unitless. EC and SAR are the primary factors that determine the usability of water for irrigation (Suarez, 2006) and irrigation is the use that has been determined to be most sensitivc to CBNG inputs (MDEQ 2003). Although EPA has no recommended 304(a) criteria for SAR and EC, states may choose to adopt criteria for SAR and EC to protect agricultural crops.

Effective April 25, 2003, the Montana Board of Environmental Review (MT-BER) adopted standards for EC and SAR for PRB streams. These standards are displayed in Table 3-6. The irrigation-season standards for the Tongue River apply year-round for the Tongue River Reservoir and that part of the river above the reservoir. These standards have been reviewed and approved by EPA and, therefore, have Clean Water Act standing (see Volume II, Hydrology Appendix, pages HYD-10 and HYD-11).

Map 3-6

Surficial Aquifers

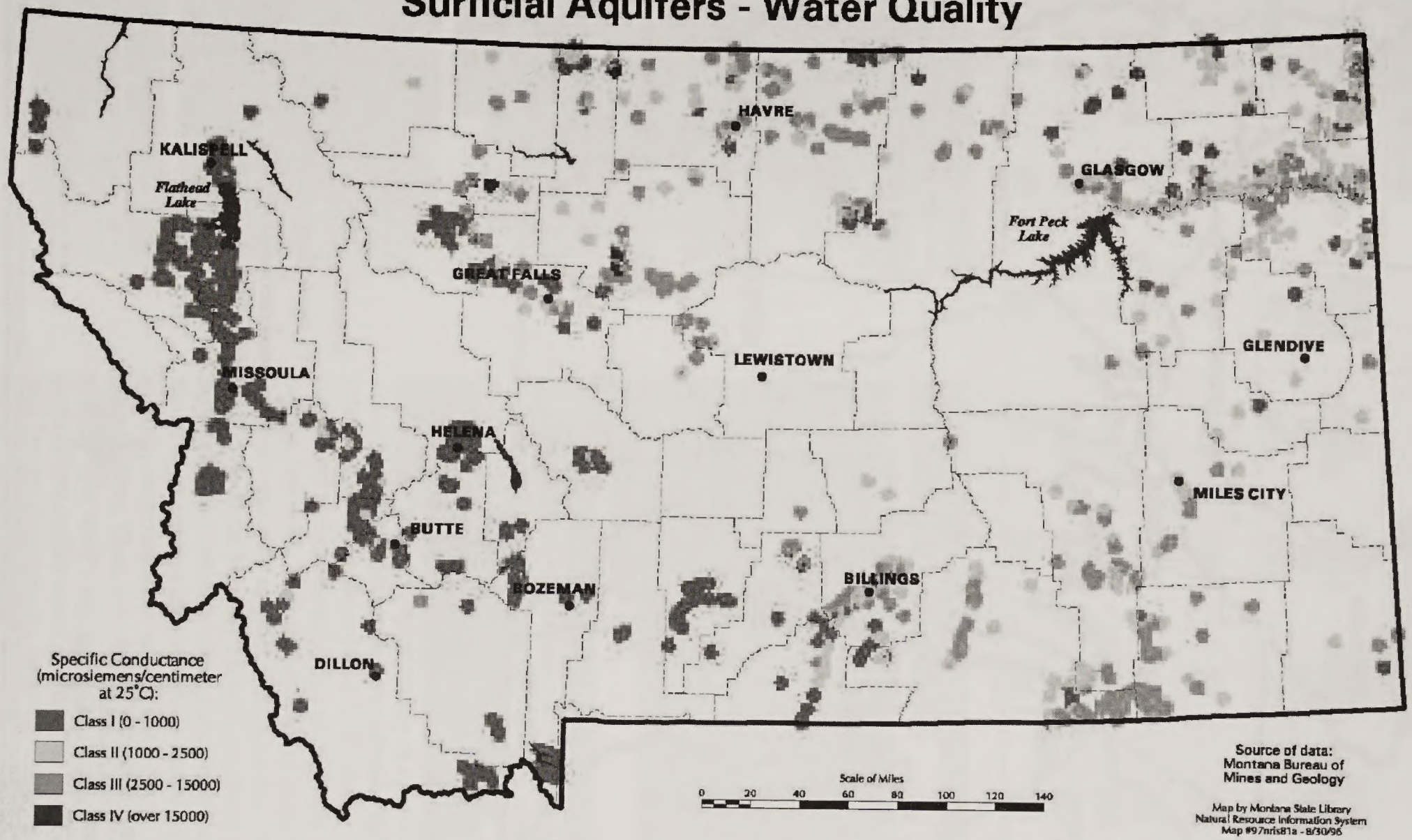


Source of data:
Montana Bureau of Mines and Geology

Map by Montana State Library
Natural Resource Information System
Map #97nris81d - 8/30/96

Map 3-7

Surficial Aquifers - Water Quality



Map 3-8: Powder River Basin Watersheds and Area USGS Gauging Stations.



Legend

1:1,400,000

0 3.5 7 14 21 28 Miles

0 15,000 30,000 60,000 Meters

- USGS Gauging Stations
- Watershed Boundaries
- Powder River Geologic Basin Bnd.

N W E S

DATA SOURCES:
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, MT.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, MT.
National Forests: 1:100,000 scale, national forests, Montana State Library/NRIS, Helena, MT.
Parks: 1:100,000 scale, parks, Montana State Library/NRIS, Helena, MT
Development Data: BLM Reasonable Foreseeable Development Scenario
Coal Occurence: Tully, 1996.

NOTE: To be used as a reference graphic only. Some data represented are at scales greater than it's source.

TABLE 3-6

MONTANA STATE NUMERICAL STANDARDS FOR PRB WATERSHEDS.

	Irrigation Season				Non-Irrigation Season			
Stream	Mean Monthly EC	Not-to-Exceed EC	Mean Monthly SAR	Not-to-Exceed SAR	Mean Monthly EC	Not-to-Exceed EC	Mean Monthly SAR	Not-to-Exceed SAR
Tongue	1,000	1,500	3.0	4.5	1,500	2,500	5.0	7.5
Tongue River Reservoir	1,000	1,500	3.0	4.5	1,000	1,500	3.0	4.5
Rosebud	1,000	1,500	3.0	4.5	1,500	2,500	5.0	7.5
Powder	2,000	2,500	5.0	7.5	2,500	2,500	6.5	9.75
Little Powder	2,000	2,500	5.0	7.5	2,500	2,500	6.5	9.75
Tributaries	500	500	3.0	4.5	500	500	5.0	7.5

On March 23, 2006 Montana BER amended portions of ARM 17.30.670, the EC and SAR standards pertaining to the non-degradation category of EC and SAR. This ruling changed EC and SAR to "harmful parameters," which modified the non-degradation non-significance threshold criteria. The essence of non-degradation is to protect high-quality state waters by limiting changes of water quality to non-significant changes or to require an "authorization to degrade" when a resultant change would be greater than the threshold. The intention of the rule is to establish a threshold where small changes (10 percent of the standard) are considered not significant. A change in water quality greater than approximately 40 percent of the standard would require additional review by MDEQ. The numerical standards for EC and SAR shown in Table 3-6 are the same under Montana's 2003 and 2006 standards.

The Northern Cheyenne Tribe has also adopted surface water quality standards for EC and SAR. The Northern Cheyenne Tribe was granted treatment as a state (TAS) status by EPA as of 8/11/2006; however, EPA has not yet reviewed these standards. As such, the Northern Cheyenne numerical standards do not have Clean Water Act standing. They do, however, set out the tribe's considered determination of the water quality needed to accomplish the following:

- Protect irrigated agriculture on the reservation.
- Protect native plant species with cultural significance and those that are integral in ceremonial and traditional aspects of the Northern Cheyenne Tribe.

These standards are summarized on Table 3-24 in the Native American Concerns Section.

By law, discharges to surface waters must be covered by a National Pollutant Discharge Elimination System (NPDES) permit. In Montana, the NPDES program is administered by MDEQ through its Montana Pollutant Discharge Elimination System (MPDES) program. Before issuing MPDES permits, MDEQ must analyze the potential for a discharge to cause exceedance of applicable numeric or narrative surface water quality standards (including non-degradation criteria).

Table 3-7 lists basic data during minimum mean monthly flows on volume and quality for the USGS stations used in the analysis of impacts to surface water in the Surface Water Quality Analysis Technical Report (SWQATR). Data for 7Q10 and maximum mean monthly flow are included in the SWQATR. Generally, water quality at a particular station varies inversely with flow volume. High-flow periods (Maximum Mean Monthly Flows) correspond to the seasonal influx of relatively low salinity, low SAR, meteoric waters, during spring snowmelt and early summer rains. Low-flow periods (Minimum Mean Monthly Flows) correspond to periods of scarce surface water, typically during the winter when streams are fed only by the influx of naturally occurring more saline, higher SAR groundwaters. Thus, high flows correspond to times of high water quality and low flows correspond to times of low surface water quality. The Tongue River near Decker illustrates this variation with a discharge rate as seen in Figure 3-6.

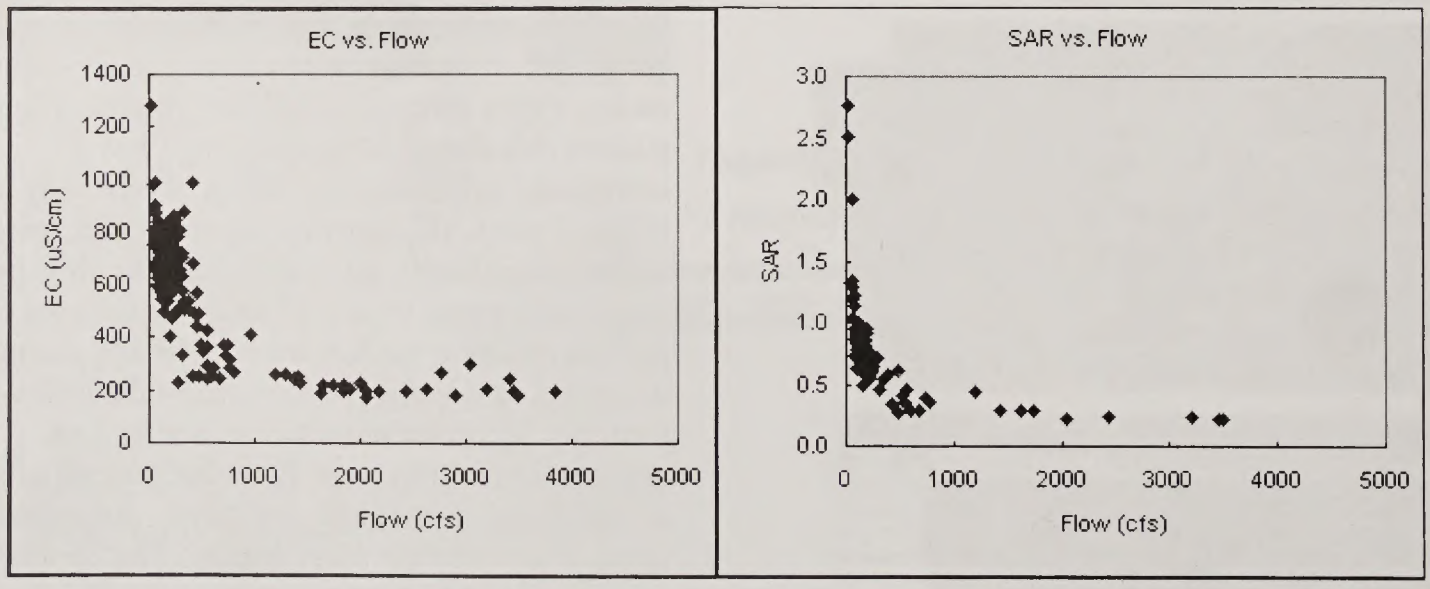
TABLE 3-7

SURFACE WATER DISCHARGE AND WATER QUALITY FOR MINIMUM MEAN MONTHLY FLOWS AT SELECTED USGS STATIONS

USGS Station	USGS Station #	Minimum Mean Monthly Flow		
		Flow (cfs)	SAR	EC µS/cm
Little Bighorn near Wyola	06289000	110	0.5	548
Little Bighorn near Hardin	06294000	123	1.0	768
Bighorn near Bighorn	06294500	1523	2.1	952
Rosebud near Kirby	06295113	1.8	0.8	1016
Rosebud near Rosebud	06296003	8.4	4.8	1780
Tongue near Decker (stateline)	06306300	178	0.9	731
Tongue near Birney Day School	06307616	183	1.1	863
Tongue at Brandenburg Bridge	06307830	207	1.4	1016
Powder at Moorhead (stateline)	06324500	145	4.7	2154
Powder near Locate	06326500	143	4.6	2287
Little Powder near Weston, WY	06324970	3.0	6.9	3300
Mizpah near Mizpah	06326300	0.3	16.6	3503
Yellowstone at Forsyth	06295000	5820	2.0	745
Yellowstone near Sidney	06329500	5764	2.0	870

Minimum Mean Monthly Flow = The lowest mean monthly flow of the station based on historical data.
EC = Electrical Conductance; SAR = Sodium Absorption Ratio; cfs = cubic feet per second
µS/cm = microseimens per centimeter
Values calculated bases upon USGS data collected through 2002
All water quality values have been determined from historical data obtained from the USGS for the flow volume in question.

FIGURE 3-6 - VARIATION IN SURFACE WATER QUALITY WITH FLOW AT USGS STATION 06306300 ON THE TONGUE RIVER NEAR DECKER, BASED UPON USGS DATA FROM NOVEMBER 1985 TO SEPTEMBER 2004



Drainage within the Powder River Basin study area is to the Little Bighorn River, Rosebud Creek, the Tongue River and the Powder River. All of these streams flow generally north to join the Yellowstone River. The central and southern portions of the Billings RMP area are drained by a series of tributaries that also flow north-northeast into the Yellowstone River; these tributaries are the Boulder, Stillwater, Rock/Red Lodge Creeks, Clarks Fork, Bighorn and Little Bighorn. Drainage within the northern portion of the Billings RMP area is to the Musselshell River, which flows eastward until it meets the boundary between Musselshell and Rosebud counties—at which point it turns northward and flows into the Missouri River.

Surface water can be impacted by cultural activity such as agriculture and industry. When groundcover is broken it exposes soil to wind and water erosion, leading to suspended sediment being brought to bodies of surface water. Artificial impoundments can cause infiltration into the soil and migration into surface water. Accidental releases of wastes can migrate into water bodies.

Watershed water-use statistics in Table 3-8 apply to those watersheds shown in Map 3-8. Table 3-8 presents data about the quantity of surface water and groundwater used in each water-use category. These data cover the area projected to have maximum CBNG potential but similar data is available for other areas of the state (USGS 1995). Surface water in these watersheds is the dominate source of water, however locally groundwater use is important for public and domestic drinking water and for stock water.

The Clean Water Act of 1972 and amendments require states to adopt standards for the protection of surface water quality. These standards are designed to maintain water quality sufficient to support the beneficial uses of the water body. Montana water bodies are classified according to the present and future beneficial uses that they normally would be capable of supporting (75-5-301 MCA). The state Water-Use Classification System (ARM 17.30.621-629) identifies the following beneficial uses:

- Drinking, culinary use and food processing
- Aquatic life support for fishes and associated aquatic life, waterfowl and furbearers
- Bathing, swimming, recreation and aesthetics
- Agriculture (crop irrigation, stock watering, etc.) water supply
- Industrial (coal mining, electrical power generation, etc.) water supply

TABLE 3-8

WATER USE (IN MILLIONS OF GALLONS PER DAY [gpd]) STATISTICS IN 1995 BY WATERSHED SURFACE AND/OR GROUNDWATER USE

Watershed	Public Supply	Domestic	Industrial	Thermo-Electric	Mining	Livestock	Irrigation	Total Ground-water	Total Surface Water
Little Bighorn	0.01/0.15	0.0/0.12	0.0/0.0	0.0/0.0	0.0/0.0	0.9/0.37	84.01/1.46	2.1	84.24
Lower Bighorn	0.61/0.02	0.0/0.25	0.0/0.01	0.0/0.0	0.0/0.44	0.3/0.73	221.6/3.67	5.12	222.51
Lower Yellowstone	2.37/0.19	0.0/0.17	0.0/0.12	16.1/0.0	0.45/0.0	1.48/0.4	250/2.56	3.44	270.4
Rosebud	0.01/0.43	0.0/0.08	0.0/0.0	0.0/0.0	0.0/1.04	0.2/0.25	8.04/0.1	1.90	8.25
Upper Tongue	0.0/0.06	0.0/0.09	0.0/0.0	0.0/0.0	0.0/0.0	0.11/0.27	23.75/0.34	0.76	23.86
Lower Tongue	0.01/0.11	0.0/0.17	0.0/0.0	0.0/0.0	0.0/1.18	0.45/0.61	36.29/0.36	2.43	39.75
Middle Powder	0.01/0.12	0.0/0.04	0.0/0.0	0.0/0.0	0.0/0.0	0.02/0.24	3.18/0.04	0.44	3.21
Mizpah	0.0/0.0	0.0/0.03	0.0/0.0	0.0/0.0	0.0/0.0	0.1/0.19	6.41/0.06	0.28	6.51
Little Powder	0.0/0.12	0.0/0.04	0.0/0.0	0.0/0.0	0.0/0.0	0.05/0.24	2.18/0.03	0.43	2.23
Lower Powder	0.0/0.0	0.0/0.06	0.0/0.0	0.0/0.0	0.0/0.0	0.5/0.24	9.65/0.09	0.39	10.15

Source: USGS 1995.

The current use classification of each water body in Montana was assigned on the basis of its actual or anticipated uses in the early 1970s. Water bodies are classified primarily by: 1) the level of protection that they require; 2) the type of fisheries that they support (warm water or cold water) or; 3) their natural ability to support use for drinking water, agriculture, etc. The water quality standards employed to maintain these uses address changes from natural conditions for such parameters as coliform bacteria, dissolved oxygen, pH, turbidity, temperature, color, toxics and other harmful substances.

When streams and other water bodies are impacted by outside agents, their support of beneficial uses can become impaired. In Montana, surface water quality is tracked by the MDEQ. Table 3-9 provides a summary of the 2004 compilation of impaired and threatened water bodies in need of water quality restoration (MDEQ 2004). Water bodies included in this list do not currently support their identified beneficial uses.

In accordance with Section 303(d) of the Federal Clean Water Act, the Montana Department of Environmental Quality (MDEQ) has prepared a list of impaired and threatened waters every 2 years since 1992. This so called "303(d) list" identifies lakes, rivers and streams that are not meeting water quality standards and establishes priorities for Total Maximum Daily Load (TMDL) development.

However, Montana, like the rest of the nation, was slow to develop TMDLs. On June 21, 2000, the U.S. District Court of Montana ordered EPA to work with the state of Montana to develop and adopt a schedule that would result in developing all necessary TMDLs for water bodies on Montana's 1996 Section 303(d) list by May 5, 2007; however a settlement agreement has extended that deadline until 2012 (Friends of the Wild Swan et al., v. EPA et al., CV 97-35-M-DWM).

TABLE 3-9
IMPAIRED WATER BODIES IN AREA OF MAXIMUM CBNG POTENTIAL

Watershed	Impaired Water body	Probable Causes of Impairment	Probable Sources of Impairment
Lower Yellowstone-Sunday	Yellowstone River (MT42K001_020) from the Bighorn River to the Carterville Diversion Dam	Other habitat alterations	Dam construction Hydro-modification
Lower Yellowstone	Yellowstone River (MT42M001_012) from the Powder River to the Lower Yellowstone Diversion Dam	Other habitat alterations	Dam construction Hydro-modification
Lower Bighorn	Bighorn River (MT43R001_010) Crow Reservation Boundary to the Mouth (Yellowstone R)	Lead Mercury Metals	Source unknown
	Bighorn River (MT43R001_020) from Yellowtail Dam to Crow Indian Res. Boundary	Nitrogen Nutrients	Other
Upper Tongue	Hanging Woman Creek (MT42B002_031from Stroud Creek to the mouth (Tongue R)	Siltation	Grazing-related sources Agriculture
	Tongue River Reservoir (MT42B003_010)	Algal growth Chlorophyll a	Domestic wastewater lagoon Agriculture
Lower Tongue	Tongue River (MT42C001_011) from diversion dam just above Pumpkin Creek to the mouth (Yellowstone River)	Flow alteration	Dam construction Flow regulation/modification Hydromodification
Rosebud	Rosebud Creek (MT42A001_011) from the mouth 3.8 miles upstream to an irrigation dam	Bank erosion Other habitat alteration	Removal of riparian vegetation Habitat modification (other than hydromodification)
	Rosebud Creek (MT42A001_012) Northern Cheyenne Reservation Boundary to an irrigation dam 3.8 miles above the mouth	Bank erosion Other habitat alteration	Removal of riparian vegetation Habitat modification (other than hydromodification)

Source: Water Quality Integrated Report for Montana, 2004. Prepared By the MDEQ Water Quality Planning Bureau (http://nris.state.mt.us/wis/environet/2004Home.html).

Based upon concern due to proposed CBNG development plans, the MDEQ and EPA are currently developing TMDLs for the Tongue, Powder and Rosebud watersheds. Impacted water bodies and TMDL issues are discussed in detail in the Hydrology Appendix.

Several of the above watersheds and impaired water bodies are shared jurisdictionally among the state of Montana, the state of Wyoming, the Northern Cheyenne Tribe and the Crow Tribe. For example, while the Rosebud watershed is located entirely within the state of Montana, it includes most of the Northern Cheyenne Reservation and part of the Crow Reservation.

CBNG Discharges in Montana

Fidelity has been discharging untreated CBNG water into the Tongue River upstream of the Tongue River Reservoir since September 1999 under MPDES permit MT-0030457. Discharge under this permit is currently occurring at a rate of approximately 820 gallons per minute (gpm) upstream of the Tongue River Reservoir (Pond Creek POD WMP). This permit originally allowed for the discharge of up to 1,600 gpm. This untreated discharge has an EC of approximately 2,145 µS/cm and a SAR of approximately 57. During Water Year 2005, the average volume discharged under this permit was 1,067 gpm (MBMG 2005). This permit was revised to comply with the requirement that permits that are limited by EC and SAR be flow-based. DEQ approved the new permit on February 3, 2006 (prior to elimination of the flow-based requirement). It has an effective duration of 5 years from April 1, 2006, to March 31, 2011. The revised permit allows Fidelity to discharge untreated CBNG-produced water from 15 outfalls. The allowed discharge rates vary seasonally, as expressed on the following list.

Annual Period	Total Flow (gpm)
Nov. 01 – Feb. 28	2,500
Mar. 01 – Jun. 30	2,375
Jul. 01 – Oct. 31*	1,600

Other effluent limits include pH (between 6.5 and 9.0), oil and grease (10 mg/l) and total suspended solids (average monthly [25 mg/l] and daily maximum [30 mg/l)] and they apply to all periods during the year.
* Total discharges to the upper reach of the Tongue River would be limited to 1,000 gpm. The remainder of permitted flows may be discharged below the final crossing of the Wyoming border.

Flow restrictions for specific conductivity are based on daily stream flow values recorded at USGS gauging station 06306300 (Tongue River at State Line near Decker). Fidelity has to conduct daily instream monitoring for specific conductivity when daily stream flow values are lower than 35 cubic feet per second (cfs). Fidelity would cease discharging to the Tongue River if the measured instream specific conductance exceeded the following values on any two consecutive calendar days:

November 1 through March 1: 2,500 µS/cm

March 2 through October 31: 1,500 µS/cm

If Fidelity ceased discharge due to these conditions, discharges could recommence until the flow in the Tongue River at the gauge station exceeded 35 cfs.

Fidelity has also received a permit (MT0030724) to discharge treated, CBNG-produced water into the Tongue River. MDEQ approved this permit on February 3, 2006, with an effective duration of 5 years from April 1, 2006, through March 31, 2011. The use of this permit began in the summer of 2006. The effluent quality limitations for this permit depend on the season of the year; however, the discharge rate is fixed at 1,700 gpm. The numerical effluent limits for average monthly discharges are presented in the list below.

Annual Period	SAR	Specific Conductivity µS/cm	Total Nitrogen (mg/l)
Nov. 01 – Mar. 01	5.0	1,500	1.2
Mar. 02 – Jun. 30	3.0	1,000	1.3
Jul. 01 – Oct. 31	3.0	1,000	1.1

Total suspended solids average monthly (25 mg/l) and daily maximum (30 mg/l) quantity applies to all periods during the year.

Powder River Gas has also been granted an MPDES permit to discharge up to 1,122 gpm of treated CBNG water immediately downstream of the Tongue River Reservoir (MT-0030660). This discharge averaged 200 gpm from April to September of 2005 (Bobst 2006). This permit requires that EC be lower than 1,000µS/cm and SAR be lower than 3.

Results of Surface Water Monitoring

Since approximately 1999, the PRB has been in an extended drought. This pattern of precipitation has affected the fundamental surface water resource of several watersheds within the PRB. The changes are documented in various publications (Bobst 2005a, Bobst 2005b, Bobst 2006, USGS 2005) as well as the hydrological reports that accompanied various plans of development submitted by CBNG developers to BLM and the state of Montana (Fidelity 2003, Fidelity 2004, Fidelity 2005a, Fidelity 2005b, PRG

2004, Pinnacle 2005a, Pinnacle 2005b). Within the Tongue, Powder, Little Powder and Rosebud Watersheds, spring runoff has diminished or vanished at times during recent years due to meager snow-pack. Flow rates observed at USGS gauging stations have been substantially lower than historical averages and many tributary gauging stations routinely exceed Montana State Numerical Standards, including not-to-exceed (NTE) limits (see Table 3-6). When current EC and SAR values are measured against historical values at similar flows, they appear to be comparable. As such it does not appear that CBNG development had a measurable effect on EC and SAR through 2005.

Groundwater

Groundwater represents less than 3 percent of the total water use in the state (Solley et al. 1995). Aside from surface water sources, however, groundwater use is locally important for domestic drinking water and stock water. Groundwater sources include wells and springs.

CBNG development has the potential to impact groundwater by decreasing the pressure within the coal aquifers (drawdown). As such, it is the subject of Montana Code Annotated 82-11-175, which was enacted by the Montana Legislature in 2003 and MBOGC Order 99-99. This order describes the authorities that pertain to CBNG development. A copy of the order is included as an appendix to the Water Resources Technical Report (ALL 2001b). The order outlines water rights issues, mitigation, monitoring plans and jurisdiction.

MCA 82-11-175 requires that CBNG operators offer a reasonable mitigation agreement to each appropriator of water who holds an appropriation right or a permit to appropriate groundwater. The point of diversion has to be within 1 mile of the CBNG well, or 0.5 mile of a water source that is adversely affected by the CBNG well.

Mitigation agreements must address reduction or loss of water resources and must provide for prompt supplementation or replacement of water from any natural spring or water well adversely affected by the coal bed natural gas well. An example water mitigation agreement is included in the Hydrology Appendix.

Groundwater within the Planning Area is found within a variety of aquifers, ranging from shallow unconsolidated alluvial aquifers associated with modern rivers to deep bedrock aquifers consisting of consolidated sandstone, limestone, or coal. Known wells within Montana's PRB are shown on Map 3-5.

Water quality and quantity vary within the Planning Area. Table 3-8 presents data about the quantity of groundwater taken on a watershed basis in each water-use category. Although groundwater only represents a small percentage of the total water use, it is critical because it provides almost 100 percent of the domestic water for farmsteads throughout the PRB. It also constitutes the largest percentage of dependable stock water, because the groundwater experiences fewer seasonal or drought effects than surface water.

Surficial aquifers within the Planning Area consist of Quaternary and Tertiary alluvium, Tertiary fluvial sand and gravel deposits and Tertiary terrace deposits. These surficial aquifers are located within the floodplains and along the channels of larger streams, tributaries and rivers. They are among the most productive sources of groundwater within the Planning Area and the quality of groundwater from surficial aquifers varies highly; the water is, however, typically a calcium-sulfate type. The quality of groundwater from alluvial aquifers within the west half of the Billings RMP area is usually good (Class I aquifers) and is suitable for human consumption. The quality of alluvial groundwater within the PRB is relatively low (Class II and III aquifers). Maps 3-6 and 3-7 show the occurrence of surficial aquifers, as well as the quality of the groundwater produced from these aquifers.

The major bedrock aquifers within the Planning Area include the coals and sands of the Fort Union Formation and the Lower Hell Creek-Fox Hills. Most CBNG is produced from coals within the Tongue River Member of the Fort Union Formation, as shown in Figures 3-1, 3-2 and 3-7. Table 3-10 contains information about the general depth, yield, geologic materials and water quality of aquifers in the PRB study area.

The Lebo Shale Member of the Fort Union formation is a regional barrier to groundwater flow (aquitard). As such, drawdown-related CBNG impacts would be limited to the Tongue River Member of the Fort Union Formation.

FIGURE 3-7

MAJOR BEDROCK AQUIFERS WITH THE PLANNING AREAS

ERA	Period	Principal Aquifers	Age:
CENOZOIC	Quaternary	Alluvium and Fluvial-Glacial Gravels	**10,000 Years**
	Tertiary	Alluvium Fluvial-Glacial Gravels (and equivalents) Terraces Fort Union Formation	**1.6 million years before present (MYBP)**
MESOZOIC	Cretaceous	Lower Hell Creek-Fox Hills Formation Judith River Formation Eagle Formation Kootenai Formation	**66.4 MYBP**
	Jurassic	Ellis Group	
	Triassic	No Principal Aquifers	**245 MYBP**
PALEOZOIC	Permian	No Principal Aquifers	
	Pennsylvanian	No Principal Aquifers	
	Mississippian	Madison Group	
	Devonian Silurian Ordovician Cambrian	No Principal Aquifers	**570 MYBP**

TABLE 3-10

PLANNING AREA AQUIFERS AND THEIR GENERAL CHARACTERISTICS

Aquifer	Common Drilling Depth	Geologic Materials	Aquifer Type	Production or Yield	Total Dissolved Solids	General Comments
AQUIFERS IN SURFICIAL DEPOSITS						
Alluvium, Fluvial-Glacial Gravels, Terrace Gravels and Flaxville Formation Gravels and equivalents.	20 to 40 ft. May exceed 250 ft.	Unconsolidated clay, silt, sand and gravel.	Commonly unconfined	Typically 5 to 50 gpm.	Range 300 to 2,200 milligrams/ liter (mg/l).	Widely used aquifer systems. Alluvial aquifers are most often used because they lie near the surface and are accessible via shallow wells and water yield is routinely quite good. They can be partially confined to completely confined with yields that may exceed 1,500 gpm in some areas. Yields from gravel deposits are more variable but water quality is usually quite good. Alluvial aquifers are vulnerable to human-caused contamination in a variety of settings.
AQUIFERS IN CENOZOIC ROCKS						
Fort Union Formation	50 to 300 ft. May exceed 1,000 ft.	Interbedded shale, siltstone, sandstone and coal.	Commonly confined, except near surface.	Typically 5 to 50 gpm.	Range 500 to 5,000 mg/l.	The Fort Union is a major source of groundwater for eastern Montana. Water is suitable for watering stock but may not be suitable for irrigation.
AQUIFERS IN MESOZOIC ROCKS						
Lower Hell Creek-Fox Hills Formations	150 to 500 ft. May exceed 1,000 ft.	Mainly sandstone with some siltstone and shale.	Confined	5 to 20 gpm. May exceed 200 gpm.	Range 500 to 1,800 mg/l.	Although the Fort Union overlies the Hell Creek-Fox Hills, the latter is often the target for water well drilling as a result of its higher quality of water.
Judith River Formation	200 to 600 ft. May exceed 1,000 ft.	Sandstone, siltstone, with some coal.	Confined	5 to 15 gpm. May exceed 100 gpm.	Range 160 to 27,000 mg/l.	
Eagle Formation	100 to 800 ft. May exceed 2,000 ft.	Interbedded sandstone and shale.	Confined	10 to 20 gpm. May exceed 200 gpm.	Range 800 to 1,500 mg/l.	Water quality is best in central Montana, poorer in eastern Montana.

TABLE 3-10

PLANNING AREA AQUIFERS AND THEIR GENERAL CHARACTERISTICS

Aquifer	Common Drilling Depth	Geologic Materials	Aquifer Type	Production or Yield	Total Dissolved Solids	General Comments
AQUIFERS IN MESOZOIC ROCKS (CONTINUED)						
Kootenai Formation	100 to 1,000 ft. May exceed 3,000 ft.	Interbedded sandstone, siltstone and shale.	Confined	10 to 30 gpm. May exceed 100 gpm.	Range 200 to 500 mg/l. May exceed 14,000 mg/l.	Used heavily near the Belt Mountains where water quality is good.
Ellis Group	300 to 2,000 ft. May exceed 5000 ft.	Sandstone, shale, limestone and dolomite.	Confined	No Data.	Generally less than 600 mg/l.	Water quality is best near outcrop areas.
AQUIFERS IN PALEOZOIC ROCKS						
Madison Group	500 to 3,000 ft. May exceed 7,000 ft.	Limestone, dolomite, anhydrite and halite.	Confined	20 to 6,000 gpm. Higher in karst areas.	Range 500 to 300,000 mg/l.	Very extensive aquifer, it underlies a large portion of the Great Plains. Water quality can be very high near recharge areas and is poorest in northeastern Montana.

The occurrence of specific bedrock aquifers and the quality of groundwater produced from these aquifers vary throughout the Planning Area. Maps 3-9 and 3-10 are maps that show the occurrence of bedrock aquifers and the quality as well as quantity of groundwater produced from these aquifers.

Water enters the aquifers during deposition of the sedimentary unit as formation water that can be salty or fresh. Later, meteoric water can enter the aquifer through outcropping recharge zones where runoff water infiltrates and is conducted into the subsurface. A small amount of water also reaches the aquifers via migration through adjacent aquitards.

Aquifer pressure can be measured in pounds per square inch (psi) or in feet of head and can vary from a low-pressure reservoir where water stands below the top of the reservoir, to an artesian aquifer where water stands above the top of the reservoir, sometimes being above ground surface and flowing from wells. Aquifer pressure can be measured in a monitoring well where water is not normally produced except for testing and sampling. Groundwater can be produced through water wells that pump or convey water from aquifers to the surface. Groundwater also comes to the surface by way of natural springs that occur where the aquifer outcrops. Springs may conduct groundwater onto the surface or into bodies of surface water.

Groundwater near an aquifer's recharge zone has been in contact with the rocks and minerals in the aquifer material for a relatively short period. As a result, the water has not had time to dissolve substantial amounts of soluble salts and minerals, so it remains fresh. The longer the water is in the aquifer, the more time it has to dissolve salts and minerals. In general, the concentration of total dissolved solids increases with distance from an aquifer's recharge or outcrop zone.

The coals within the Tongue River Member of the Fort Union Formation are the primary CBNG targets in Montana. Groundwater within the Tongue River Member of the Fort Union Formation has been shown to evolve in a predicable manner along its flow path (Van Voast and Reiten 1988). Cation exchange is one of the normal processes that increase salinity, where calcium and magnesium are replaced by sodium, as the groundwater comes into contact with sodium-rich shale. In deeper portions of the aquifers, sulfate is removed by reduction reactions. This reduction causes the salinity of the water to decrease, while increasing the ratio of sodium to calcium and magnesium. The result is a moderately saline (EC of ~1,800 to 2,500 µS/cm), sodium-bicarbonate-rich water in the coal seam aquifers where CBNG is expected to be produced.

The sands and coals of the Tongue River Member of the Fort Union Formation are important aquifers in the Powder River and Billings RMP areas. The Tongue River Member of the Fort Union formation contains substantial laterally continuous layers of low permeability shale interbedded with coals and sands. The coal units are typically overlain and underlain by shale units (Wheaton and Donato 2004). As such, most of the impacts from CBNG-related drawdown will be to the coal aquifers.

Observed CBNG Related Groundwater Drawdown

Groundwater is being produced from many PRB water wells. Known wells are shown on Map 3-5. Since 1999, CBNG production has drawn down the pressure within the coal seam aquifers. This drawdown can extend beyond the field's boundaries. The present state of the groundwater resource in PRB coal seams can be addressed by examining existing monitoring well conditions.

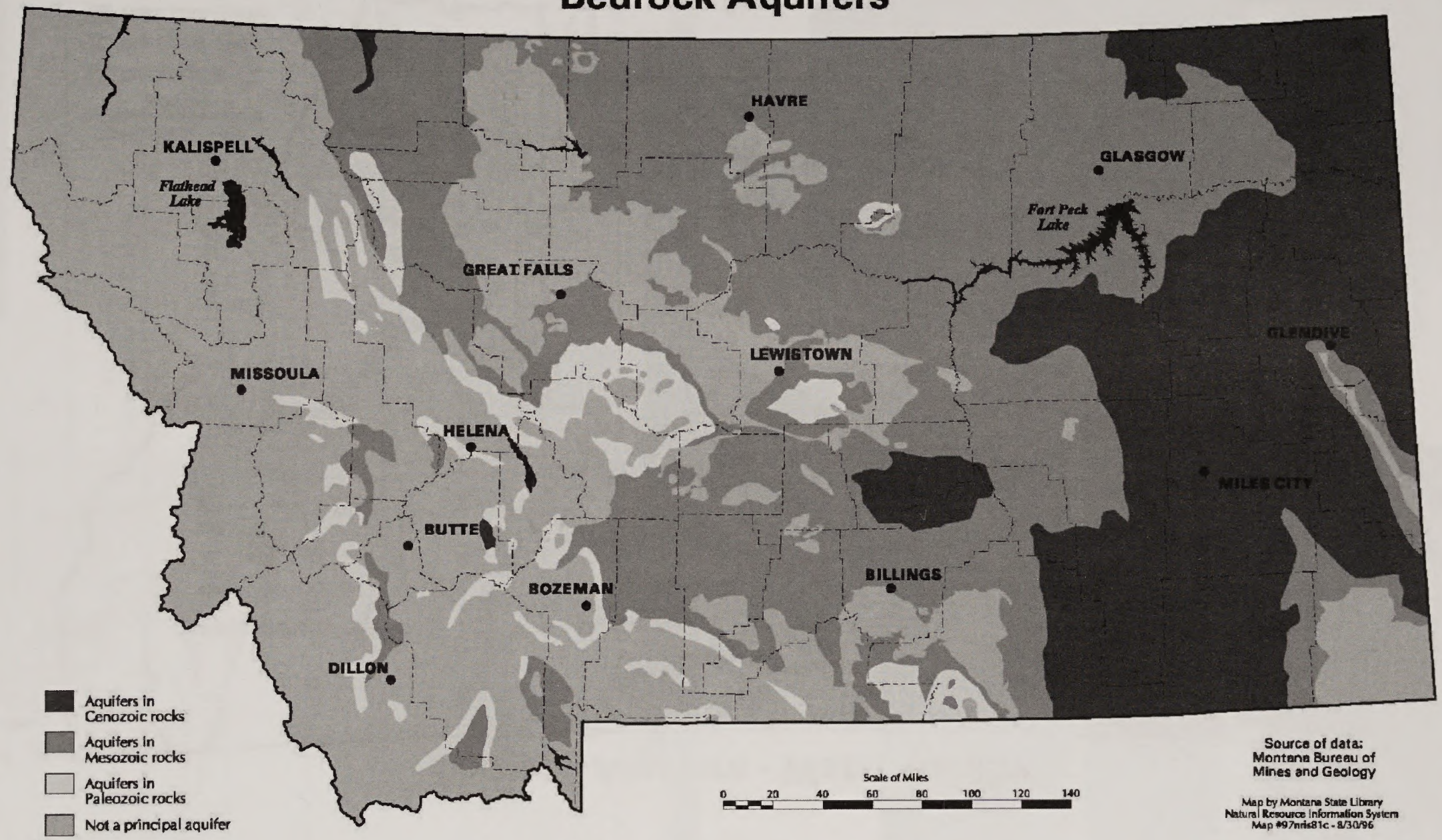
One hundred sixty-two wells were used to monitor regional groundwater levels in the area of Montana's CBNG production. After 6 years of CBNG production, the 20-foot drawdown contour has been interpreted to extend about 1.5 miles beyond the edges of the CX field (Wheaton et al. 2006). This drawdown is in line with, but somewhat less than, the Statewide EIS predictions for this period of development. No drawdown has been observed within units other than the developed coals. Drawdown is sensitive to the presence and orientation of faults, which are flow barriers (Wheaton and Donato 2004).

Within and next to Montana's CX Ranch field, Fidelity Exploration & Production Company used water-level readings from approximately 250 wells to derive water drawdown maps (Fidelity 2005a, Fidelity 2006). The Fidelity Exploration & Production Company maps showed in-field drawdowns up to 594 feet, with the interpreted 20-foot drawdown extending up to 2 miles away from production. This drawdown is in line with the Statewide EIS predictions for this period of development.

Several Montana CBNG operators were contacted to discuss use of water mitigation agreements and their experiences using them. Fidelity Exploration & Production Company, J.M. Huber Corporation and Pinnacle Gas Resources, Inc., responded to the inquiry. Fidelity reports that its CBNG production since 1999 has resulted in impacts to six water wells near CX Ranch field (Williams 2006). Fidelity Exploration & Production Company drilled new wells to replace these six wells. The company has not

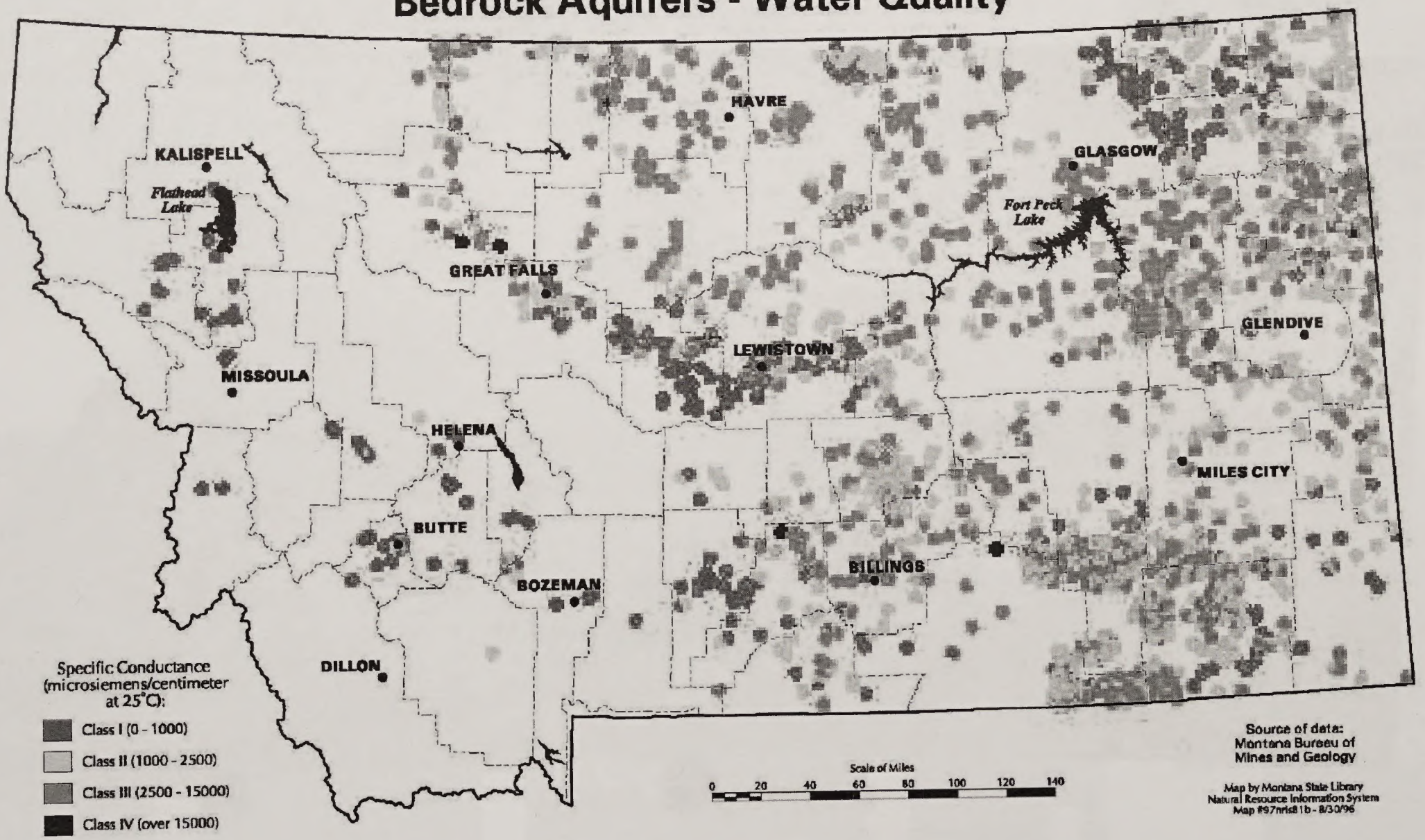
Map 3-9

Bedrock Aquifers



Map 3-10

Bedrock Aquifers - Water Quality



received any complaints regarding springs that may have been impacted (Williams 2006). Furthermore, Fidelity reports that it has not had any formal complaints of gas in wells. The company, however, indicated if there were any, its mitigation agreement would be used (personal communication, Williams, 2006). A copy of a typical water mitigation agreement can be reviewed in the Hydrology Appendix.

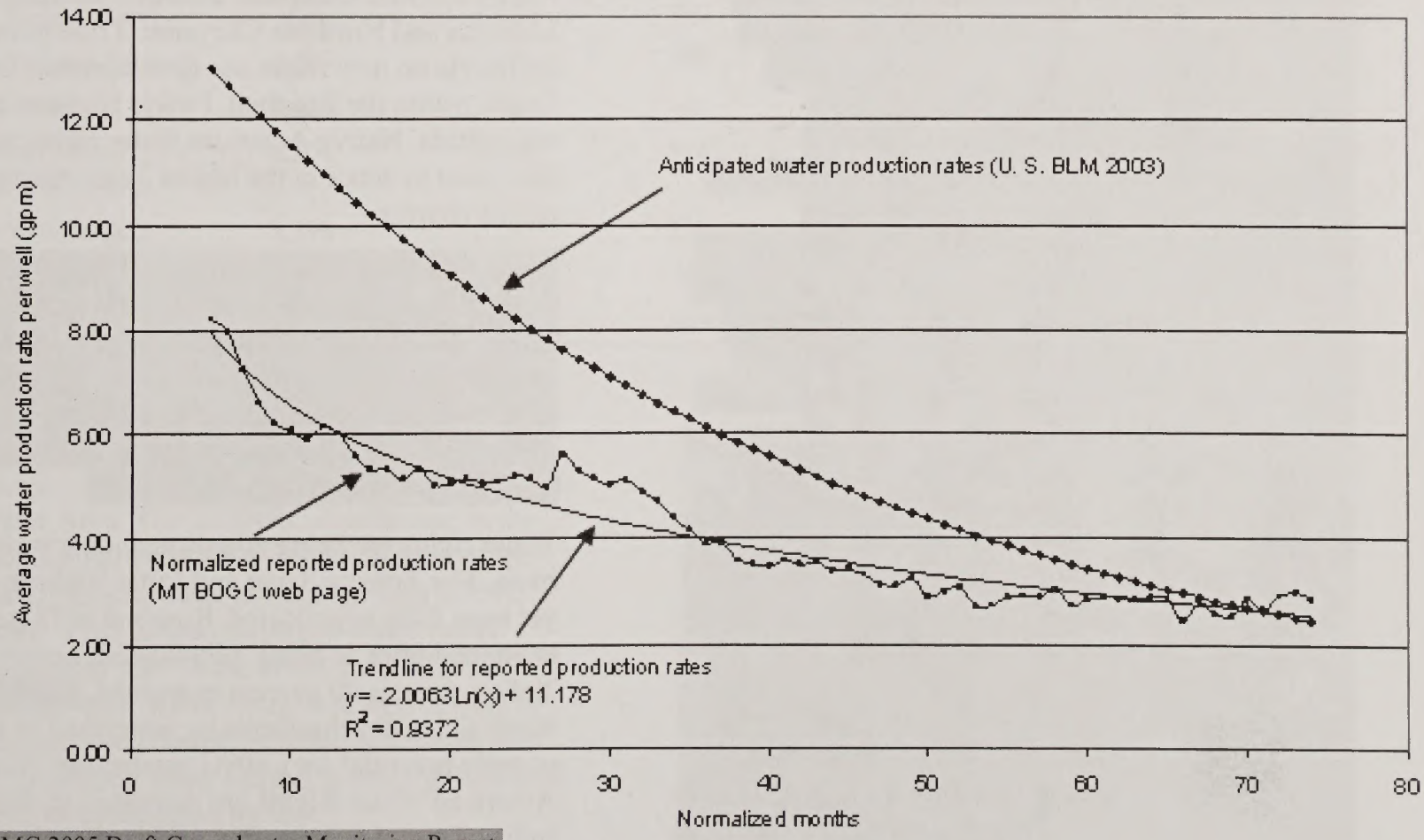
Huber reported receiving complaints from 12 well owners about reduced water pressure in Wyoming. Huber has drilled six new wells so far and is trying to settle with the other six well owners in a small subdivision where the wells have been impacted. The company has offered to install a small domestic water supply system, but the residents have so far refused. Huber also received one complaint regarding a spring going dry, but upon investigation it was determined, with concurrence from the owner, that the drought was probably responsible because of the shallow nature of the spring. With regards to natural gas in wells, Huber stated it had had some problems a few years ago; there were two wells with elevated levels of natural gas. Huber replaced the wells. The company also installed three cisterns at local ranches where it suspected the water wells might start venting natural gas. The cisterns function as degassing vessels that are open to the atmosphere and allow natural gas to vent before water is piped into the house or barn. The company is not aware whether these water wells are experiencing increasing methane, but the wells are completed in a coal seam being produced. Huber stated it considers any water well with elevated natural gas as covered by its mitigation agreement.

Pinnacle reported one complaint from a prominent ranch family that filed suit for "future water shortage." Pinnacle has had no specific complaints about reduced water pressure in wells, springs drying up, or elevated natural gas in domestic wells.

The Montana Bureau of Mines and Geology (MBMG) issued a 2005 Draft Groundwater Monitoring Report indicating the observed production rate for water is somewhat lower than the assumption used in the statewide CBNG EIS. Figure 3-8 is a graphic that depicts the assumed water production rate versus the normalized observed rate of production.

FIGURE 3-8

OBSERVED WATER PRODUCTION VERSUS CBNG FEIS ASSUMED WATER PRODUCTION RATE FOR THE MONTANA PORTION OF THE POWDER RIVER BASIN



Source: MBMG 2005 Draft Groundwater Monitoring Report.

The pumping rates BLM estimated for early years (which determined the peak rates and drove the analysis) are somewhat greater than observed. However, most of the new wells have been installed in areas near existing development, so initial head would have been less than the wells used to extrapolate the trend. In areas of virgin pressure, the original curve is probably more reasonable. Also, basin-wide, some of the coals are substantially thicker and would, therefore, yield more water and would be expected to have higher pumping rates.

MBMG's Draft 2005 Groundwater Report also indicates that drawdown associated with CBNG development appears to be causing a slight increase in the volume of water drawn from the Tongue River Reservoir to the Upper Dietz coal seam. This coal seam sub-crops in the reservoir, so the reservoir has historically recharged it. Assuming the faults in this area function as flow barriers and regional aquifer characteristics can be applied, the volume of water being drawn from the reservoir can be estimated using Darcy's Law (Fetter 1994). This analysis indicates CBNG-related drawdown has increased the flow from the reservoir to the coal seam by approximately 2.4 acre-feet per year (from 19.2 ac-feet/year to 21.6 ac-feet/year). This is equivalent to an increase of 1.5 gpm.

Observed Infiltration Effects

Storage ponds have often been used to manage CBNG-produced water. Those ponds that are not lined and are located on permeable materials can infiltrate water and create saturated flow to the subsoil or bedrock beneath the ponds. New publications have provided some additional information on this management process (Wheaton and Brown 2005, Brinck et al. 2004). Three infiltration ponds were selected for research: one in the CX Ranch field of Montana and two south of the CX Field in Wyoming, but still in the PRB. These reports documented downward infiltrating waters beneath CBNG ponds, but impacts were highly site-specific. The Montana pond has impacted a monitoring well located approximately 200 feet downgradient from the pond; the well documented a water-level rise of 25 feet in overburden, an increase of TDS from 2,566 to 3,548 mg/L and a decrease in SAR from 43 to 14. An off-channel infiltration pond in the Coal Creek area of Wyoming apparently impacted bedrock aquifers beneath the pond; both TDS and SAR were affected near the pond. Farther south in the PRB, in the Beaver Creek area, two on-channel ponds have received CBNG-produced water. After a year, information on the effect from discharge into these ponds is lacking and there is no indication of what has happened to groundwater near the pond.

In general, it appears infiltrated CBNG water dissolves soluble minerals in the subsurface along its flow path. This results in water with a higher TDS and lower SAR than the original CBNG water (Table 3-11). The resultant water is dominated by ions of Mg and SO_4 (Wheaton and Brown 2005). It appears salts are flushed from the system over time (Wheaton et al. 2005). The duration and geographic extent of effects to the underlying groundwater are poorly defined. Impoundments that are lined, or are located on low-permeability materials, do not have the potential to infiltrate at a rate that will result in saturated flow. If saturated flow does not occur, impacts to underlying groundwater are unlikely, since the salts would be "parked" in the unsaturated zone and the water would migrate as vapor.

Water Rights

Water rights in Montana are the subject of The Montana Water Use Act (Title 85, Chapter 2, MCA) of 1973, which became effective July 1, 1973. Water rights existing prior to that date are to be finalized by state courts. Water rights applications since that date are secured through a MDNRC permit system. In addition, some water rights are protected under federal and state statutes.

Water rights on some BLM-administered lands are protected by the Federally Reserved Water Rights for Public Springs and Water Holes, Public Water Reserve 107, pursuant to Executive Order dated April 17, 1926. Compacts between the state of Montana and Northern Cheyenne Tribe have placed moratoria on new water use developments on Tribal Lands within the Rosebud, Lower Bighorn and Pryor watersheds. Native American water rights are discussed in detail in the Indian Trust Assets section of this chapter.

Watershed water-use statistics in Table 3-8 apply to those watersheds shown in Map 3-8. Table 3-8 presents data about the quantity of surface water and groundwater used in each water-use category. These data cover the area projected to have the maximum CBNG potential, but similar data are available for other areas of the state (USGS 1995).

Water rights are being adjudicated on a watershed basis. The Tongue River and Little Bighorn have not yet been fully adjudicated, Rosebud is 78 percent examined prior to being adjudicated, Lower Yellowstone is 90 percent examined. Table 3-12 lists water rights developments by watershed in the area of main potential for CBNG production. Native American Water Rights are discussed in detail in the Indian Trust Assets section of this chapter.

TABLE 3-11

GROUNDWATER QUALITY FOR THE MONTANA PORTION OF THE POWDER RIVER BASIN - SELECTED GROUNDWATER QUALITY DATA COLLECTED FROM WATER SUPPLY WELLS LOCATED THROUGHOUT MONTANA POWDER RIVER BASIN

County	Judith River Formation		Hell Creek /Fox Hills Formation		Fort Union Formation		Quaternary Alluvium	
	Avg. TDS (mg/l)	Avg. SAR	Avg. TDS (mg/l)	Avg. SAR	Avg. TDS (mg/l)	Avg. SAR	Avg. TDS (mg/l)	Avg. SAR
Big Horn	936	54	1,440	14	1,658	8	2,118	5
Rosebud	2,465	31	1,376	35	1,595	16	1,516	9
Powder River	No data	No data	890	35	1,882	15	2,783	5
Custer	No data	No data	896	37	1,810	31	1,665	8
Treasure	2,312	64	1,985	56	1,782	32	2,437	10
Weighted Average	2,100	42	1,148	37	1,892	18	2,014	7

Avg. TDS = Average Total Dissolved Solids
Avg. SAR = Average Sodium Adsorption Ratio
Source: MBMG 2001.

TABLE 3-12

WATER RIGHTS DEVELOPMENT SUMMARY BY WATERSHED

Watershed	Number of Pre-1973 Developments		Number of Post-1973 Developments		Number of Pending Water Rights Permits
	Surface	Ground-water	Surface	Ground-water	
Rosebud	765	408	27	210	1
Upper Tongue River	820	504	35	136	3
Lower Tongue River	2,407	2,278	98	662	1
Little Powder	1,320	741	66	166	3
Lower and Middle Powder and Mizpah	5,204	2,816	314	4	7
Lower Yellowstone	3,398	1,330	278	804	4
Little Bighorn	786	387	35	96	0
Lower Bighorn	1,522	596	105	419	3

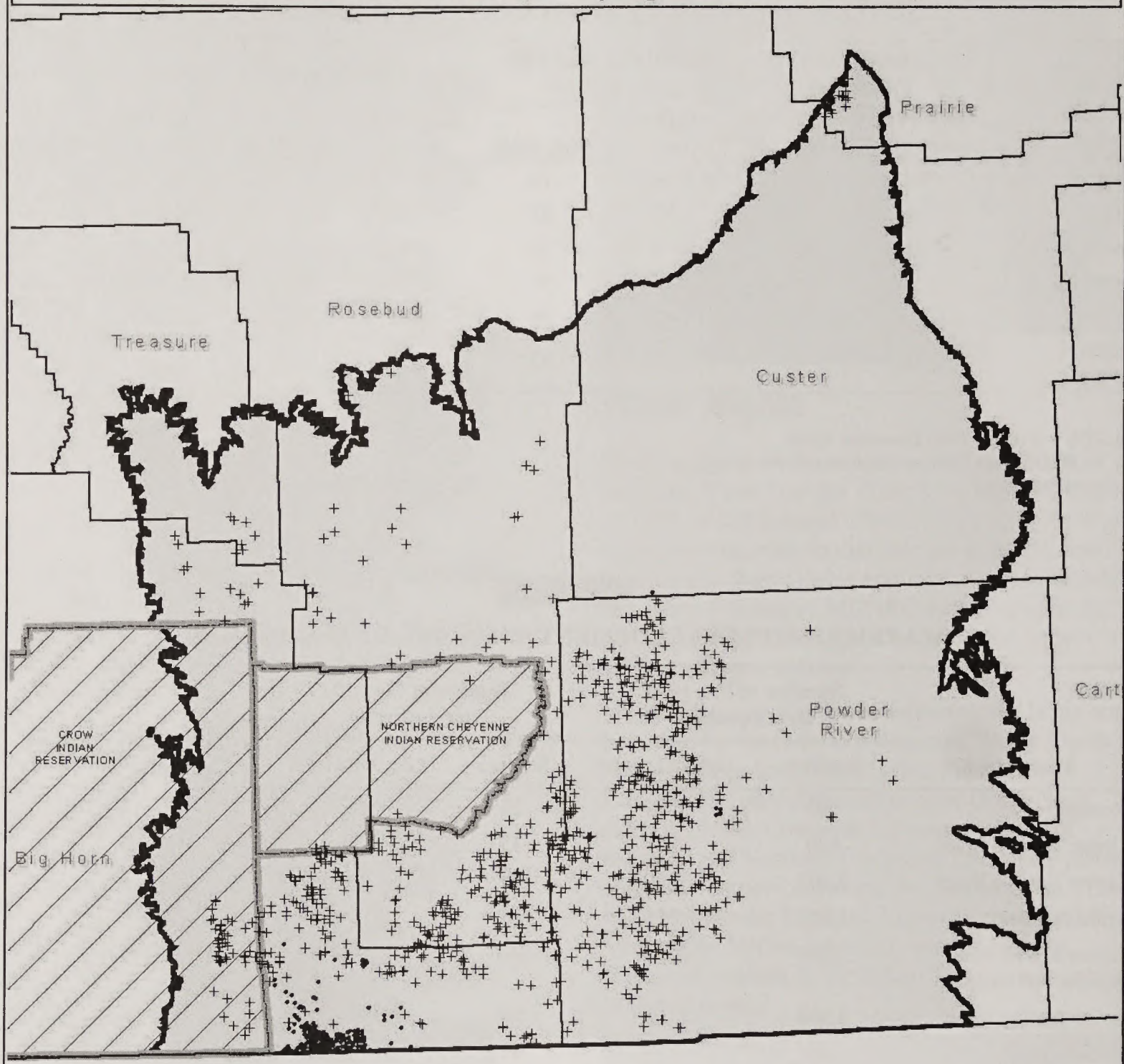
Source: DNRC 2001.

The Montana Water Use Act (85-2-506) established the designation of the Powder River Basin Controlled Groundwater Area. The MDNRC established in the Controlled Groundwater Area in anticipation of the withdrawal of groundwater associated with CBNG development. Two issues relating to water rights were addressed as part of the order. First, CBNG operators must offer water mitigation agreements to owners, as discussed above. Second, beneficial uses of CBNG -produced water require water rights issued by MDNRC as established by law.

Existing Wells and Springs

Map 3-11 shows the existing springs in the Montana portion of the PRB and existing CBNG wells. Spring locations, as supplied by MBMG (2002), are widely scattered across the basin. As noted above, Fidelity Exploration & Production Company, operator of most CBNG wells in the CX Ranch field, has received no complaints of impacted springs. Furthermore, it is unlikely that CBNG production would impact springs, because if subsurface coal seams were in direct contact with surface springs, water and methane gas would have long ago leaked to the surface, leaving the coal seam depleted.

Map 3-11: Current CBNG Production, and Springs in the Powder River Basin



Legend

- Springs
- CBNG
- Powder River Geologic Basin
- American Indian Reservations

1:1,300,000

20 10 0 20 Miles

20,000 10,000 0 20,000 40,000 Meters

N W E S

DATA SOURCES

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana
Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office.
Water Well Locations: Montana Bureau of Mines & Geology Water Well Database.
CBM Potential: 1:250,000 scale, Geologic Map 60, Montana Bureau of Mines & Geology.

The fact that a coal seam produces gas strongly suggests it is isolated from a surface outlet.

Water Management

The management of produced water associated with CBNG development is one of the primary issues relating to existing, as well as future, CBNG development and production operations. These issues develop from both the volume and the quality of the water produced. Initial water production rates common to CBNG wells in the Montana portion of the PRB range from approximately 15 to 20 gpm. Over time, water production rates decline, with average water production rates ranging from 2 to 5 gpm over the life of a well. As of July 2005, CBNG water production within the CX Ranch Field in Montana averaged approximately 3 gpm per well.

In addition to the overall volume of water produced, the quality of CBNG-produced water has characteristics that make managing it challenging and complex. The quality of CBNG-produced water is generally good, but, depending on the area of the basin where it is produced, it may have a SAR ranging from 30 to 60 and TDS ranging from 500 to 2,500 mg/L. Both the quantity and quality of CBNG-produced water can also vary based on the specific coal seam(s) being developed. The combination of CBNG-produced water quantity and quality and the variation of these parameters found from one site to the next, as well as between producing coal seams, may require having a variety of water management options available for use.

While initial CBNG development depended almost exclusively on untreated discharge to surface waters, a number of other CBNG-produced water management options are currently being used or considered within both the Montana and Wyoming portions of the PRB. Numerous water management options have been discussed in recent reports, including Kuipers, et al. (2004) and CDM (2004). The following list includes the major water management options being used, or proposed for use, in the PRB:

- Class V—injection into shallow sands
- Class V—reinjection into coal seams
- Class IID—injection into deep underground non-drinking water sources reservoirs
- Class IIR—injection into secondary recovery projects
- Treatment and beneficial use or discharge
- Industrial uses
- Managed irrigation
- Livestock watering – cattle feedlots
- Public water supply
- Impoundments

A brief discussion of these water management options is provided in the following paragraphs. The water management options discussed are not intended to be all-inclusive. Rather they demonstrate a variety of options, including beneficial uses, that have to be considered and their implementation is largely site-specific, depending on the quality and quantity of water produced from a particular area or coal seam.

Class V Injection into Shallow Sands

Underground injection into shallow sand aquifers offers a potential way to manage some quantity of water produced from CBNG wells. This type of injection uses boreholes drilled into shallow sands classified as USDWs and then involves pumping the produced water into those aquifers. Injection would be limited to permeable sands, either between or below, producing Fort Union coals. Implementation of this option would depend on the quality of the produced water and groundwater within the shallow sand injection zone, as well as current and future beneficial uses of the shallow sand injection zone. Beneficial uses could include, but would not be limited to, public drinking water, agriculture, aquifer recharge, storage and industrial uses. When injection is considered using Class V type wells for beneficial uses, pretreatment of the produced water may be required before it is injected into an aquifer for either recharge or storage.

The feasibility of underground injection as a tool for managing produced water involves several technical considerations, including geology, economics and engineering. These considerations can vary considerably based on site-specific conditions. Within particular study areas, it has been shown that suitable sand injection targets underlie approximately 9 percent of the site (Wheaton and Reddish 2005).

Class V Reinjection into Coal Seams

This alternative includes the option of reinjecting CBNG-produced water into an underground coal seam. At the present time, there appear to be no PRB wells actively injecting produced water into coals. There are, however, records of at least nine wells that historically injected into shallow nonproductive coals in the PRB. These wells gave varying results from less than 100 barrels per day (bpd) to more than 2,000 bpd. The receiving coals ranged in depth from 45 to 400 feet below land surface. There are no records of operators attempting to inject into depleted coal seams (Likwartz, 2005).

The alternative has, however, been tested on a very limited basis. There are several reasons why reinjection of produced water into coal seams has not been widely used. These include the following:

1) The reintroduction of water into a producing coal seam increases the hydrostatic pressure and slows the natural gas production.

2) 2) Non-produced coal seams are saturated and cannot receive the volumes of water produced.

3) 3) The financial investment to construct a pipeline to bring the produced water to a suitable coal seam is high.

4) 4) Not all produced water has to be treated or disposed of, but it can be and is used for beneficial purposes.

5) 5) The possibility of causing vertical fractures in the coal seam exists, thereby causing the injected water to be injected not only into the target seam but into another seam of formation.

6) 6) The possibility exists of causing the pressure in the seam to increase and thereby increase the water pressure in any domestic water well or stock well to such an extent that the affected well would no longer be useable.

Coal seams serve as water supply aquifers throughout many PRB areas. Many of the shallow coals in the basin are unconfined and open to the surface, often via clinker zones. Under unconfined conditions, the coal seams do not usually produce CBNG, as any gas that was present has escaped into the atmosphere. Coals can also be present as confined aquifers isolated from the surface by formations such as shales and claystones. Confined coals can often produce water and CBNG. When fluids no longer can be produced from these coals, they are depleted. Injection may be possible into non-productive coals as well as depleted coals, but each has its own drawbacks and barriers to use.

Coal is designated nonproductive because the methane either was never generated or has leaked off. If it has leaked off, then the coal seam is an unconfined aquifer and its fluids can reach the surface and discharge, although the time required to do so may be a few days or many hundreds of years.

A depleted coal seam well may have been produced for a number of months or years and it may no longer produce CBNG in economic quantities. Such a well would have a lower reservoir pressure than when it began producing. If the reservoir pressure has been reduced, the reservoir may accept large volumes of fluid at relatively low injection pressures.

A coal seam that is depleted in one well or one project area may still be productive in an adjacent CBNG project area. If an operator applies for a Class V injection permit in a depleted well, an offsetting operator may protest this application by arguing that any injection by the other operator will retard adjacent production, thereby reducing the mineral estate under lease. For this reason, successful injection applications will have to be sufficiently separated, either geographically or stratigraphically, from active CBNG production from the same coal seam.

Technical parameters relating to the feasibility of injection into coal seams are site-specific. They primarily include the porosity and permeability of the injection coal seam and injection pressures required to inject the proposed volume of CBNG-produced water.

Class IID Injection into Deep Non-USDW Reservoirs

Class II injection wells, typically used for conventional oil and gas operations, have the potential to be used for CBNG water disposal. EPA classifies deep injection wells used for disposal below any USDW as Class II wells. Class II injection wells are subdivided as either IID (for disposal) or IIR (for secondary oil recovery).

Class IID permits are issued for injection into an underground formation that contains water with a TDS greater than 10,000 mg/L or is an exempted aquifer. These deep Class IID wells may be able to accept large volumes of water in an environmentally safe manner; however, success with these wells in the PRB has been limited, with only ~30 percent being successful (Sattler et al., 2006). Class IID injection zones typically are very deep and are isolated from drinking water sources by thick, impermeable, confining zones.

Technical parameters relating to the feasibility of deep well injection are site-specific. They primarily include a high enough porosity and permeability and low enough pressure within the deep injection zone to allow for injecting large volumes of water. Water quality of the injection zone with respect to TDS is also a factor. The distance and cost of running pipelines to injection wells and the cost of drilling the injection wells would also be factors.

Class IIR Injection into Secondary Recovery Projects

CBNG-produced water could be used to supply water for injection into Class IIR wells as part of secondary

oil recovery (water-flood) projects. Class IIR injection is done by oil producers to more efficiently produce oil from conventional oil fields. Under this option, CBNG operators could pipeline their produced water to oilfields being flooded by other operators in an effort to produce additional oil. Water floods could inject large volumes of water up to 50,000 bpd.

Technical issues relating to the feasibility of using CBNG water in a water flood would include its chemical compatibility with the particular oil reservoir. Injected water that is chemically incompatible with water already in the oil reservoir could result in precipitation of solids. This could reduce permeability of the reservoir, resulting in lower production. The distance and cost of running pipelines to water-flood fields would also be a factor.

Treatment and Beneficial Use or Discharge

In general, CBNG-produced water is characterized by elevated levels of salinity, SAR and TDS. The concentrations of each of these parameters would vary based on location and the coal seam being developed and might require treatment before beneficial use or discharge. A variety of treatment technologies could be used to improve the quality of this water and allow for increased beneficial use or discharge. Ion exchange and reverse osmosis are two common examples.

Treatment processes would depend both on treatment goals and influent water quality. Continual adjustments to treatment processes might be required if influent water quality varied from the expected quality. Recent and proposed changes in discharge standards might require upsizing or modifying treatment equipment to meet the new standards. The costs associated with treatment systems might be a factor.

Industrial Uses

Coal mines in the PRB use large volumes of water for dust control. CBNG-produced water is currently used at local coal mines to control dust and for equipment washing, as well as for other uses. CBNG-produced water has to be transported to the active mines for this option to be feasible.

Another potential industrial use of CBNG-produced water would be at electric generating power plants, which have a considerable need for cooling water. Nationally, water availability has been a limiting factor in the development of new power plants. With the current and projected volume of produced water from CBNG development, consideration of using CBNG-produced water beneficially would be reasonable for cooling at power plants.

Technical aspects of this option would involve variations in the quality and quantity of CBNG-produced water relative to location and coal seam(s) developed. Electric generating plants generally are designed to accommodate cooling water of a relatively high and consistent quality. Additionally, CBNG-produced water would have to be available to the power plant for a long enough time to make it worth the power plant's effort to treat or install piping to access the water.

Managed Irrigation

Irrigation is one of the more common and proven beneficial uses of CBNG-produced water in the PRB. Good sources of water for irrigation are only abundant near rivers and reservoirs; therefore, good sources of usable, CBNG-produced water are desirable for farmers and ranchers. The problems associated with using CBNG-produced water for typical surface irrigation would result from its high EC and SAR values. These problems might include soil crusting on the surface, dispersion and salt accumulation in the root zone.

With any irrigation project, a user must ensure that saturated flow to outcrop or to groundwater would not occur. Once the water infiltrated, it would dissolve naturally occurring salts along its flow path. Saturated flow to outcrop would result in development of a potentially low-quality surface discharge (seep). Saturated flow to groundwater would cause the salts from the CBNG-produced water and those dissolved along the flow path to discharge to groundwater; potentially affecting groundwater quality. This could be avoided by ensuring that the water application occurred at agronomic rates.

Soil amendments (typically gypsum and native sulfur) have been used to offset the high SAR of the CBNG-produced water. This keeps the soil permeable and leaching fractions sufficient to keep the root zone salinity at an acceptable level.

Systems where amendments are added to the water rather than the soil (gypsum beds and sulfur burners) are also used. These function in essentially the same way as the soil amendments, only the constituents are added through a different path.

Subsurface drip irrigation (SDI) supplies water to crops by a system of hoses and pipes buried in a network of trenches under the field. The water interacts with the salts, which have naturally accumulated in the subsurface (Ca-Mg sulfates), to reduce the SAR. Again, the reduced SAR allows for

acceptable root zone salinity within the root zone to be maintained by using a sufficient leaching fraction. Technical aspects of this option relate to the salinity of CBNG-produced water, which may be a problem in arid and semiarid areas since any leaching above the subsurface irrigation tubing would occur only as the result of rain. Thus, salts may accumulate in this area during the season as the plants extract water and leave the salts behind.

Livestock Watering - Feedlots

Livestock watering is another common and proven beneficial use of CBNG-produced water in the PRB. Livestock watering would require relatively small quantities compared to the amounts of water produced in the basin; however they may result in better livestock distribution. Selected CBNG wells could also be left unplugged for livestock watering purposes, if the surface owner consented.

CBNG-produced water could also be used to support feedlots. Water uses at a feedlot could include consumption by cattle, irrigation of forage crops and waste management. CBNG-produced water in the PRB is typically of sufficient quality for livestock watering without any treatment.

Public Water Supply

Public water supplies can be limiting factors in both residential and industrial development. CBNG-produced water could be used as input for a public water supply; the water could be used to ensure continued growth and development. No towns at present are known to use CBNG-produced water as part of their water supply.

Technical aspects of this option would involve the quality of CBNG-produced water. CBNG-produced water might not be high enough quality to use in a public water supply without treatment. Additionally, the cost of piping CBNG-produced water to towns for use, as well as the continued long-term supply of the resource, would also be factors.

Impoundments

Impoundment construction in connection with oil and gas development must be permitted by MBOGC and might also require permits from DEQ, DNRC and other agencies. Surface storage is sometimes appropriate for produced water, depending on water quality and the availability of beneficial use. An impoundment for storing and managing produced water can be constructed as either an on-channel or off-channel facility. On-channel impoundments are defined as any impoundment constructed by building an embankment or dam across a stream, intermittent channel, or watercourse where the stream valley is depressed enough to permit storing 5 or more feet of water (USDA, NRCS, 1982). The land slope may range from gentle to steep.

Off-channel impoundments are defined as any impoundment constructed by digging a pit or dugout in a nearly level area (USDA, NRCS, 1982) outside an existing stream channel or intermittent watercourse. Off-channel impoundments can be built in gently to moderately sloping areas where their capacity is obtained both by excavating and by building a dam (USDA, NRCS, 1982).

One important difference between the two types of impoundments is the potential for stored produced water to infiltrate and discharge to surface waters. Due to the nature of the alluvium present in most on-channel impoundments in Montana, the path to surface discharge is essentially direct; that is, water infiltrated into the alluvium can communicate directly with the water in the river or stream. This situation can lead to regulatory issues. On channel impoundments may also intercept surface flows unless a by-pass is constructed.

General siting criteria for constructing an impoundment can include geomorphology, surface soil type, stratigraphy, presence and nature of both shallow and deep groundwater, hydrogeology, regional geology and vegetation. These factors, plus produced water quantity and quality, would all have to be considered when determining the use of impoundments for managing produced water.

Indian Trust Assets

The U.S. Department of the Interior (DOI) Departmental Manual 303 DM 2 defines Indian Trust Assets (ITAs) as lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians. DOI Departmental Manual 512 DM 2 requires all of its bureaus and offices to explicitly address anticipated effects on ITAs in planning, decision and operating documents.

Beyond the maintenance of tangible assets, the federal government also has a trust responsibility to be considerate of the general well being of the tribes. This responsibility includes recognizing the Indian culture as an important value and to carefully consider Indian cultural values when conducting planning efforts. Indian cultural values include their unique way of life, ceremonial practices, spiritual beliefs, family values and worldview. The DOI Department Manual 512 DM 2 also asserts an affirmative responsibility to ensure the tribal health and safety, to consult on a government-to-government basis with tribes who may be affected by proposed actions, to disclose all applicable information and to fully incorporate tribal views in its decision-making processes.

Background

Lands associated with a reservation or public domain allotments are examples of ITAs. Natural resources that exist within Indian reservations such as standing timber, minerals and oil and gas are ITAs. Treaty rights, water rights and hunting and fishing rights may also be ITAs. Other ITAs may consist of financial assets held in trust accounts or intangible items such as Indian cultural values, ITAs are a product of the unique history and relationship of the U.S. government with various American Indian tribes. There is no similar relationship between the Montana State government agencies and sovereign dependent Indian tribal nations (like the Northern Cheyenne and Crow Tribes). See Map 1-1 for the general location and boundaries of the reservations and Table 3-13 for ITA acreages.

Identification Methods

The BIA is required to develop inventories of ITAs for all Indian tribes. The only ITAs in the Planning Area are the actual Indian reservation lands, natural resources and rights belonging to the Northern Cheyenne, Crow and the Turtle Mountain Band of Chippewa.

Applicable Laws

Federal

The DOI Department Manual 512 DM 2 requires all DOI Bureaus and offices to explicitly address anticipated effects on ITAs in planning, decision and operating documents. This order also requires descriptions of how decisions will conform to the DOI's trust responsibilities. Furthermore, DOI Department Manual 303 DM 2 outlines the principals for managing ITAs.

TABLE 3-13

INDIAN TRUST ASSETS

Tribe	Acreage of Reservation	Trust Acres	Tribal Surface Acres	Individually Allotted Surface Acres	Tribal Mineral Acres	Individually Allotted Mineral Acres	Private Acreage
The Northern Cheyenne	445,000	442,193	444,000	138,211	444,000	138,211	2,087
The Crow	2,296,000	1,491,569	455,719	1,035,850	405,888	824,427	804,431
Turtle Mountain Public Domain Allotments*	N/A	61,520	N/A	61,520	N/A	61,520	N/A

Source: Madison 2001.

*Not all of these acres lie within the Planning Area.

The Crow Tribe

The Crow Reservation is located in south-central Montana and comprises nearly 2,296,000 acres. Access is via Interstate 90 or U.S. Highway 87. The reservation is bordered on the south by the state of Wyoming, on the east by the Northern Cheyenne Reservation and on the northwest by the city of Billings, which is Montana's largest metropolitan area. The reservation encompasses the Little Bighorn Battlefield and approximately 3,600 square miles of rolling prairie and rugged foothills drained by the Bighorn River. The BIA Realty Office indicated that the tribe has some 455,719 surface acres and 405,888 acres of mineral rights. There are another 1,035,850 acres that have been individually allotted and 824,427 acres of allotted mineral rights.

There are about 10,083 Crow tribal members, the majority of which live on the reservation. The Crow language is spoken by more than 80 percent of the tribe. Headquarters are at Crow Agency, Montana, just south of Hardin, Montana. The total labor force on the Crow Reservation is 3,902. The unemployment rate is 61 percent. The average per capita income is $4,243.

Water Rights

The Crow have existing water rights held in trust by the United States. The Crow Tribe has not negotiated a water rights compact with the state of Montana.

Mineral Rights

The BIA Realty Office has stated that the Crow have mineral right assets totaling some 405,888 subsurface acres and another 824,427 allotted mineral acres.

Cultural Resources

The Crow also considers cultural and prehistoric resources located within their reservation to be ITAs. At present, an unknown number of archaeological resources are on the reservation. Sites are known to exist on the reservation, but the tribe reserves the information. These sites can consist of burials, trails, rock features, lithic scatters, house pits/rings, rock-shelters, caves, bison kills and petroglyphs.

The Northern Cheyenne Tribe

The Northern Cheyenne Indian Reservation occupies about 445,000 acres in eastern Big Horn and southern Rosebud counties, Montana. Access is provided by U.S. Highway 212. The reservation covers nearly 695 square miles and is bordered on the east by the Tongue River and on the west by the Crow Reservation. According to the BIA Realty Office, the tribe has 442,193 trust acres and 444,000 of surface and mineral estate lands. There are 138,211 individual allotted acres on the reservation.

The Northern Cheyenne Tribe also has trust lands located off the reservation. The tribe acquired two tracts of land immediately west of the Tongue River Reservoir. These tracts are approximately 160 acres each and include the mineral estates.

The tribe also has two larger tracts immediately south of the reservation and north and west of the Zook Creek Wilderness Study Area (WSA), respectively. The tribe obtained these tracts under an agreement with Consolidated Coal Company in 1981. The tribe acquired the surface rights, but the mineral rights were retained by the company. One of these tracts, known as the Moreland Ranch, is where the tribe pastures its buffalo herd.

The total tribal population is 7,473, of which approximately 4,212 Northern Cheyenne live on or near the reservation. The tribal headquarters are in the town of Lame Deer. The total work force of the tribe is approximately 2,437 and the unemployment rate is 71 percent according to the BIA Indian Labor Force Report (U.S. BIA 1999). According to the U.S. Bureau of the Census (Census 2000), the per capita income is estimated at $7,736 and the poverty status as of 1999 was 46.1 percent.

Water Rights

The Northern Cheyenne Tribe has existing water rights held in trust by the U.S. The 1908 U.S. Supreme Court ruling in *Winters v. U.S.* (207 US 564) ruled that water rights needed to develop Indian reservations were reserved and this includes both groundwater and surface water rights.

The Northern Cheyenne have a water rights compact with the state of Montana and own a significant amount of water in the Tongue River Basin, including a principal portion of the Tongue River Reservoir.

The Northern Cheyenne Tribe has developed draft water quality standards and is currently discussing an agreement with the state of Montana and the BLM regarding preservation of beneficial uses. The draft water quality standards have been submitted to the EPA for approval.

Mineral Rights

The Indian Minerals Development Act (PL 97-382, 25 USC 2101) and the Federal Oil and Gas Royalty Management Act of 1982 (PL 97-451) provide that information about mineral development of Indian Trust lands are proprietary to the individual tribe and may not be disclosed without consent. The BIA Realty Office has stated that the Northern Cheyenne have

mineral right assets totaling some 444,000 subsurface acres.

Cultural Resources

The Northern Cheyenne Tribe considers cultural resources located within their reservation to be ITAs. Sites are known to exist on the reservation, but the information is reserved by the tribe. These sites can consist of burials, trails, rock features, lithic scatters, house pits/rings, rock-shelters, caves, bison kills and petroglyphs.

The Turtle Mountain Public Domain Allotments

There are approximately 61,520 acres (Madison 2001) of trust lands allotted to the members of the North Dakota Turtle Mountain Tribe scattered throughout 2,000 square miles of Montana.

In 1906, the Burke Act provided that individual tribe members could receive allotments of reservation land. At that time, parcels of 160 acres each were allotted to individuals of the Turtle Mountain Tribe in Montana. These allotments, although not grouped as a reservation, are within the Planning Area. These Trust lands are subject to the same leasing and development procedures as for the reservations.

Lands and Realty

A variety of land uses exist throughout the Planning Area, including agricultural (crops and grazing); roads and highways; railroads; utility rights-of-way (ROW) for electrical power lines and telephone; communication sites; oil and gas production and pipelines; residential; commercial and light industrial uses; mining; municipalities; and recreation.

Table 3-14, *Land Administration*, shows surface ownership in acres by county for federal, state, tribal and private lands. It also shows that approximately 69 percent of the land is private land. The majority of the private land is agriculturally based (grazing and crops). The next largest ownership is federal lands at 15 percent. Federal lands include lands managed by the BLM, USFS, National Park Service, U.S. Bureau of Reclamation (USBR), U.S. Fish and Wildlife Service (USFWS)) and USDA. BLM and USFS lands are used for grazing, timber production, mineral production (except for the Custer National Forest, which is excluded from surface coal mining by Section 522 of the SMCA of 1977) and year-round recreation activities. USBR lands are used for water storage and recreation. National Park Service lands are used for recreation. USFWS lands are used for wildlife refuges and recreation. USDA lands are used for livestock and range research (Fort Keogh Livestock and Range Research Laboratory).

Since completion of the Statewide Document, BLM has managed two land exchanges within the Planning Area (both in Carter County). The Johnston Exchange resulted in trading 454 acres of private land for 480 acres of BLM land to be used for recreation and grazing access. The Higgins Exchange resulted in trading 551 acres of private land for 560 acres of BLM land, also designated for recreation and grazing access.

Tribal lands comprise 10 percent of the land in the Planning Area. They are used for cattle production, mining, logging and lumber production, residential and recreation on the Northern Cheyenne Reservation. Major land uses on the Crow Reservation include agriculture, mining and recreation (Madison 2001).

State lands comprise the least amount of land in the Planning Area at 5 percent. This land is used for grazing, mining, timber production, oil and gas production, state parks and recreation activities. State lands are composed of school trust land administered by DNRC Trust Land Management Division, land owned by DNRC Water Resources Division and land owned by other state agencies. Uses vary by agency. School trust land uses include agriculture, grazing, mineral exploration and mining, aggregate production, recreational activities, oil and gas exploration and production, timber production and special uses, for example, wind turbines for energy production. School trust lands also have pipelines, power lines, telephone lines, roads and highways, home site leases and cabin site leases, depending on the situation.

Roads and highways include interstate, U.S., state and off-system roads open to the public—county, local and private roads open to public use. Table 3-15 lists the number of miles of each type within the Planning Area.

Railroad ROW crisscross the counties in the Planning Area. Railroads in the Planning Area transport goods such as grains, intermodal containers and coal. Table 3-16 indicates the approximate miles of railroad ROW within the Planning Area for each county, by railroad.

There are existing gas pipelines in all the counties being studied. Some existing roads, utilities and gas lines could be used as part of the network for new CBNG installations.

TABLE 3-14

LAND ADMINISTRATION

County	Total Acres	Federal						State Lands	County Lands	Tribal Lands	Private	Water
		BLM	Forest Service	National Park Service	Bureau of Reclamation	U.S. Fish & Wildlife Service	U.S. Department of Agriculture					
Big Horn	3,209,390	27,301		2,497				64,305		1,611,968	1,492,196	11,122
Carbon	1,319,798	217,469	325,674	26,798		261		44,061		192	700,492	4,850
Carter	2,134,533	503,915	90,620					143,994	329	531	1,394,517	627
Custer*	1,557,683	183,975	9				46,522	93,684	346		1,233,147	
Golden Valley	752,882	8,073	23,547			304		48,866			671,135	958
Musselshell	1,197,365	100,514				11,427		76,093			1,007,178	2,153
Powder River	2,110,643	257,147	340,415					143,339			1,369,699	43
Rosebud*	1,503,407	77,986	95,613					64,920		242,194	1,020,141	2,553
Stillwater	1,154,939	5,412	192,526			4,055		56,308			896,637	
Sweetgrass	1,191,687	15,496	279,860					48,539			844,077	3,716
Treasure	629,822	840						39,058		10,666	576,006	3,252
Wheatland	914,081	1,418	65,035					75,976			768,725	2,927
Yellowstone	1,695,363	76,864			1,666	284		73,638		142,997	1,392,373	7,540
Total	19,371,593	1,476,411	1,413,299	29,296	1,666	16,331	46,522	972,781	675	2,008,017	13,366,433	39,774

Sources: Land Ownership, Montana State Library/NRIS, Helena, Montana, 2005. Created from GIS intersection of 1:100,000 scale county boundaries with 1:100,000 scale Land Ownership.

*Acreage reflects only that portion of this county included in the Planning Area.

Note: Acreage changes from the Statewide Document reflect actual changes in ownership, as well as changes to GIS source data from ongoing maintenance of the data layer and/or NRIS Library.

TABLE 3-15

MILES OF ROAD/HIGHWAY

County	Interstate	U.S.	State	Off-System
Big Horn	88.3	63.1	23.0	4,625.9
Carbon		106.9	60.6	1,310.4
Carter		38.3	84.3	906.9
Custer	42.8	25.8	57.8	1,636.6
Golden Valley		29.0	12.5	1,453.4
Musselshell		99.6		1,952.4
Powder River		64.6	55.1	1,925.7
Rosebud	41.9	26.6	51.3	2,296.2
Stillwater	46.0		23.1	1,625.6
Sweetgrass	39.3	52.6	0.1	1,386.4
Treasure	26.2			742.9
Wheatland		79.9		1,278.3
Yellowstone	101.4	88.1	41.8	3,290.6
Total	385.8	674.5	409.4	24,430.7

Sources: 2000 Census roads, Montana State Library/NRIS, Helena, Montana, 2005. Created from GIS intersection of 1:100,000 scale county boundaries with 1:100,000 scale 2000 Census roads.

Note: Road/highway mile changes from the Statewide Document reflect actual changes, as well as changes to GIS source data from ongoing maintenance of the data layer and/or the NRIS Library.

TABLE 3-16

MILES OF RAILROAD ROW

	Railroad		
County	BNSF[1]	Montana Rail Link	Tongue River Railroad (Proposed)
Big Horn	119		19
Carbon	55		
Custer	44		44
Golden Valley	38		
Musselshell			
Rosebud	104		64
Stillwater		46	
Sweetgrass		44	
Treasure	61		
Wheatland	28		
Yellowstone	124	57	
Total	573	146	127 (proposed)

Sources: Railroads, Montana State Library/NRIS, Helena, Montana, 2005. Created from GIS intersection of 1:100,000 scale county boundaries with 1:100,000 scale Railroads.

[1]BNSF—Burlington, Northern and Santa Fe Railroad.

Note: Railroad mile changes from the Statewide Document reflect actual changes, as well as changes to GIS source data from ongoing maintenance of the data layer and/or NRIS Library.

Livestock Grazing

Most BLM grazing allotments involve only one permittee; however, there are several multi-permittee allotments. There are no other uses or control of public lands granted by issuance of a grazing permit. The length of grazing periods varies from seasonal to year-long use. Most ranch operators using the allotments are cow-calf operations with sheep operations coming in second. Most allotments have several range improvements such as fences, stock ponds, pipelines, springs, windmills, seedings, wells and access roads for better control of livestock for management purposes (BLM 1992).

In the Planning Area, approximately 1,066 allotments cover 1.4 million acres of BLM-administered lands, including 351 allotments covering approximately 0.4 million acres in the Billings RMP area and 715 allotments covering approximately 1.0 million acres in the Powder River RMP area.

These allotments are used to graze cattle, sheep and horses. The main class of livestock using public lands is cattle (93 percent). Current BLM data indicates authorized livestock use on BLM-administered grazing allotments totals about 260,000 animal unit months. These allotments include active-use, non-use and exchange-of-use options (Tribby 2001; Padden 2001; Haas 2001). An AUM is the amount of forage necessary to support one cow and her calf, or five sheep, for one month.

Native American Concerns

There are seven federally recognized Indian tribal organizations in Montana. They are the Assiniboine and Sioux Tribes of Fort Peck (Sioux Division of Sisseton/Wahpetons, the Yantonias, the Teton Hunkpapa and the Assiniboine bands of Canoe Paddler and Red Bottoms), the Blackfeet Tribe, the Chippewa Cree Tribe, the Confederated Salish and Kootenai, the Crow Tribe of Montana, the Fort Belknap Indian Community (the Assiniboine and the Gros Ventre) and the Northern Cheyenne Tribe. Non-federally recognized tribes also reside in Montana: the Little Shell Band of Chippewa of Montana and the Métis.

Tribal enrollment within these organizations is recorded as 61,203 individuals or nearly 6.6 percent of the state's population. Within this population there is an average unemployment rate of 61 percent and a high level of poverty (U.S. BIA 1999).

The majority of these native people reside on seven Indian reservations throughout Montana. The reservations are the Crow, Northern Cheyenne, Fort Peck, Fort Belknap, Rocky Boys, Blackfeet and the Flathead. Two reservations are within the SEIS Planning Area: the Crow and Northern Cheyenne.

The Crow Reservation

Much of the information in this section has been summarized from the Crow Indian Reservation's *Natural, Socio-Economic and Cultural Resources Assessment and Conditions Report* (Crow Tribe 2002). Readers should refer to that document for more detailed information. This document can be downloaded from the MDEQ CBNG web page at http://www.mt.blm.gov/mcfo/cbm/eis/CrowTribeNarrativeReport/index.html.

The Crow Reservation is located in south-central Montana and comprises nearly 2,296,000 acres. Access is via Interstate 90 or U.S. Highway 87. The reservation is bordered on the south by the state of Wyoming, on the east by the Northern Cheyenne Reservation and on the northwest by the city of Billings, which is Montana's largest metropolitan area. The reservation encompasses the Little Bighorn Battlefield and approximately 3,600 square miles of rolling prairie and rugged foothills drained by the Bighorn River. The BIA Realty Office indicated that the tribe has some 455,719 surface acres and 405,888 acres of mineral rights. There are another 1,035,850 acres that have been individually allotted and 824,427 acres of allotted mineral rights.

Mountains, residual uplands and alluvial bottoms make up the topography of the Crow Reservation. The three principle mountain areas are the Wolf Mountains (CHEETIISH) to the east and the Bighorn (BASAWAXAAWUUA) and Pryor Mountains (BAAHPUUO ISAWAXAAWUUA) to the south. Sloping downward to the north from the mountains are rolling upland plains. The plains constitute the bulk of the reservation and vary in altitude from 3,000 to 4,500 feet. The alluvial bottomlands are located along the Bighorn River, Little Bighorn River and Pryor Creek drainage systems.

Reservation communities include Crow Agency, Saint Xavier, Yellowtail (Fort Smith), Lodge Grass, Wyola and Pryor. The Crow Tribe recognizes six districts within the reservation. The six districts are Bighorn, Black Lodge, Lodge Grass, Pryor, Reno and Wyola. (Crow Tribe 2002).

Tribal Government

The U.S. signed treaties in 1825, 1851 and 1868 with the Crow Tribe. These legal documents define the tribe's relationship with the U.S., recognized their rights as a sovereign government and established reservation boundaries. The U.S. first recognized the Crow Tribe by Treaty in 1825 (ratified August 4, 1825. 7 Stat. 266, proclaimed February 6, 1826) and this recognition has continued through today as evidenced by the Federal Register notice of July 12, 2002. The Treaty of 1851 established the Crow Reservation. The Tribal government has authority within the boundaries of the reservation for all ROW, waterways, watercourses and streams, running through any part of the reservation.

The Crow Tribe of Indians repealed its 1948 constitution and By-Laws in July 2001. The Crow Constitution of 2001 established a three-branch government, Executive, Legislative and Judicial. Each branch possesses separate and distinct power. Elected Executive, Legislative and Judicial branch officials hold 4-year terms. Judgeships consist of a Chief and two Associate Judges. The Crow Tribal Law and Order Code governs the structure of the Tribal Court.

The Legislature consists of 18 representatives from six Legislative Districts (three representatives from each district) in the reservation. The Legislative Branch promulgates and adopts laws, resolutions, ordinances, codes, regulations and guidelines in accordance with the 2001 Constitution and federal laws. These legislative measures include taxes and licensing to protect and preserve property, wildlife and natural resources.

The Executive Branch includes a Chairman, Vice-Chairman, Secretary and Vice-Secretary. The Executive Branch is empowered to administer funds and to enforce laws, ordinances, resolutions, regulations, or guidelines passed by the Legislative Branch.

Demographics

As of 2000, 69 percent of the 10,220 enrolled members of the Crow Tribe were living on the Crow Indian Reservation (reservation). The off-reservation population of enrolled members included 850 (8 percent) in Hardin and 2,340 (23 percent) in other areas, primarily Big Horn County, Billings (Yellowstone County) and other Montana and Wyoming counties near the reservation. In the 2000 Census, the reservation's population was 6,890, an increase of 15 percent from 1980. Native Americans made up 75 percent of the reservation's population. Ninety-four percent of the reservation's population was in Big Horn County and the other 6 percent in Yellowstone County.

Between 1990 and 2000, the population of the Crow Indian Reservation increased by 520 (8 percent) compared to an 11.8 percent increase for all of Big Horn County. Average annual population growth has been less than 1 percent since 1980. The median age on the reservation is 27.6, compared to 37.5 for Montana as a whole. The population is distributed between the reservation communities of Crow Agency, Dunmore, Garryowen, Lodge Grass, Wyola, Pryor, Saint Xavier and Yellowtail and rural areas outside of the communities.

In the 1990 Census, 41.7 percent of persons on the Crow Indian Reservation were living below the poverty level. Poverty status on the reservation as determined by the BIA for 1999 was 38 percent (Table 3-17).

Social Organization

As of 2000, there were 2,280 housing units on the reservation. Of these, 1,320 (58 percent) were owner-occupied, 24 percent were rented-occupied and 18 percent were vacant (presumably due to substandard conditions). Household size in 2002 was 3.5 for owner-occupied and 3.9 for renter-occupied. The reservation has a shortage of adequate housing for the needs of the population. The Crow Tribal Housing Authority identified 250 homes with more than one family in the households in 2002 and a waiting list of 300 families in need of housing. In 1997, the BIA identified a need for 1,040 new housing units on the reservation and 890 families in need of housing. Temporary housing off the reservation is available in Hardin, just north of the reservation in Montana and in Sheridan, Wyoming, about 25 miles south of the reservation.

The Crow Indian Reservation Natural, Socio-Economic and Cultural Resources Assessment and Conditions Report describes in detail the public facilities and services in five of the larger communities on the Crow reservation. Telephone, gas and electric utilities are provided by a variety of county and other utility companies. Educational facilities include elementary, junior high and high schools and Little Big Horn Community College. Varying levels of public water and sewer systems are provided, depending on the community. Some of these systems are in need of maintenance and repair. The communities also have varying levels of medical, police and fire protection services.

The reservation has eight elementary schools, three high schools and the Little Big Horn Community College. The three high schools are located in Lodge Grass, Pryor and Hardin. From coal mining revenues, the schools at Hardin and Lodge Grass have become two of the wealthiest in the state. Public schools are also available in both Billings and Hardin. Approximately 70 percent of members have a high school diploma and more than 6 percent have a Bachelor's Degree or higher.

TABLE 3-17

TRIBAL POVERTY RATES AMONG THOSE EMPLOYED (1999)

Tribe	County	Total Tribal Enrollment	Percent Employed but Below Poverty Guideline
Crow Tribe of Montana	Big Horn County, Yellowstone County	10,083	38%
Northern Cheyenne Tribe	Big Horn County, Rosebud County	7,473	26%
Montana (all tribes)		61,203	33%

Source: BIA 1999.

Economics

The most recent employment information for the reservation is from the 1990 Census. In 1990, total employment on the reservation was 1,660. The tribal and federal governments are the largest employers. The Crow tribal government employed 400 persons in 2002. Agriculture (330, 20 percent), education (240, 15 percent) and retail trade (230, 14 percent) were the largest industry sectors. Private wage and salary (780, 47 percent) and government (590, 36 percent) were the largest classes of employment. According to the 1990 Census, the reservation's labor force (persons 16 years and older) was 2,380, with an unemployment rate of 30.4 percent. Much higher rates (61 percent) are reported by BIA statistics from 1999 (Table 3-18).

Page 3-38 of the Statewide Draft Oil and Gas EIS states that tribal members' 1999 per capita income was $4,243. By comparison, per capita income for Big Horn County was $13,329 and the state of Montana was $21,229. In the 1990 Census, median household income for the reservation was $17,270, compared with $19,900 for Big Horn County and $22,988 for the state.

Agriculture has been the historic base of the reservation economy. Agricultural crops include livestock, wheat, barley, oats, corn, sugar beets, alfalfa and hay. In 2000, the Montana State University/Big Horn County Agricultural Extension Service estimated the values of crops and livestock on the reservation were $20.9 and $35.5 million, respectively.

Natural resources (land, water, coal, oil and gas, timber and sand and gravel) also contribute to the employment base and income on the reservation. The Absaloka Mine is located within five miles of the reservation's northern boundary and employs between 40 and 75 Crow tribal members. The Statewide Draft Oil and Gas EIS (p. 3-40) states there have been 172 conventional oil and gas wells drilled on the reservation. These wells have been drilled by non-Indian interests through leases with the Crow Tribe. In 1985, 20 companies had 709 oil and gas leases with the Crow Tribe. The reservation has about 36,000 acres of commercial forest in the Wolf and Pryor mountains; timber units are generally leased to non-Indian interests for harvesting.

The Crow Tribe receives government revenue from its natural resources through numerous land leases, boundary settlement allotments and income-producing trusts generated through coal, mineral, oil, gas and timber reserves. The majority of these trusts are administered by the U.S. Government's Office of Trust Fund Management.

The Crow Tribe's economic development plans incorporate the reservation's resources such as agriculture, energy, tourism and recreation and commercial enterprises. The tribe is currently working with programs from federal agencies to prepare a strategy for comprehensive economic development. As part of the federal Economic Development Administration's community economic development strategy (CEDS), the tribe is preparing an economic development plan to balance development and protection of the reservation's resources.

Air Quality

The air quality and climate of the Crow Reservation is similar to that of the regions described earlier in Chapter 3. The Crow Reservation is classified as a PSD Class II area.

The reservation is located in a part of Montana that has a moderate climate relative to its latitude. Snow rarely accrues for long periods of time because of the warm Chinook winds, which originate from the mountains in the West. This portion of Montana is also known for its "Indian Summers" which frequently extend into November. The mean annual temperature is 45.5°F with a summer high of 110°F and a winter low of -48°F. The bulk of the reservation varies from 12 to 18 inches annual precipitation, depending on the elevation.

The tribe is currently in the process of developing and rewriting its codes and standards for air quality.

TABLE 3-18

AVERAGE ANNUAL UNEMPLOYMENT RATES BY RESERVATION

	1996 Rate (%)	1999 Rate (%)	Change 1996-1999
Crow Reservation	15.5	14.9	0.6
Northern Cheyenne Reservation	26.0	18.7	7.3

Souree: Montana Department of Labor & Industry, Research & Analysis Bureau, Local Area Unemployment Statistics (2001a).

Culture and History

The Crow Tribe's native name is the Apsalooke, literally translated, "children of the large beaked bird." Early explorers mistook the signing for Apsalooke, the flapping of one's hands like the wings of a bird in flight and called them the Crow. The Crow were historically recognized as matrilineal and their social system was clan based. The original 13 clans of the Crow Tribe are as follows:

- Ashilaaliio—Newly Made Lodges
- Ashshitchite—Big (husky) Lodges
- Ashiiooshe—Sore (burnt) Lip Lodge
- Uuwuutashshe—Greasy Mouths
- Uussaawaachia—Brings Game Home Without Shooting
- Xuhkaalaxche—Ties Things Into a Bundle
- Ashpeennuushe—Filth Eaters
- Ashkapkawia—Bad War Deeds
- Bilikooshe—Whistling Water
- Ashxache—Hair Left on the Hide Lodge
- Ishaashkapaaleete—Cropped Ear Pets Lodge
- Ishaashkakaawia—Furious Pets Lodge
- Ashbatshua—Traitorous Lodge

Of these three are extinct and the remaining 10 recognized clans have been consolidated into the following six; Bad War Deeds, Big Lodges, Greasy Mouths, Ties Things Into a Bundle, Traitorous Lodge and Whistling Water (Reed, G. 2002).

The Crow people were originally part of the Hidatsa Tribe, which originated in the upper mid-west of the present U.S. Their subsistence and lifestyle was agriculture based. The Mountain Crow separated from the Hidatsa in North Dakota in the 1550s into eastern Montana and during the 1600s expanded along the Yellowstone River drainage. The River Crow moved into central Montana in 1670 and by 1720 were concentrated in the Yellowstone and Bighorn River drainages.

With the introduction of the horse, people in the Plains tribes became more mobile and began intruding on each other's hunting grounds. The Crow became known for their skill with horses. By 1800 the Powder, Bighorn, Yellowstone and Wind River drainages became areas of continuing conflict between the Lakota, Northern Cheyenne, Arapaho, Blackfeet, Gros Ventre, Assiniboine and Crow.

In 1806, the Lewis and Clark expedition spent one month in the Crow Territory, which aided in the Crow developing good relations with fur traders. Fur trading posts were established and fostered the development of the Crow as middlemen in the regional transfer of goods and the Crow prospered. The 1840s saw a period of massive small pox and flu epidemics in which, along with battles between native peoples, the majority of Crow died.

Treaties were signed with the U.S. in 1825, 1851 and 1868. The 1825 Treaty, a treaty of friendship, established a relationship with the U.S. Government. In the Fort Laramie Treaty of 1851, the Crow lost control of the Powder River Basin but gained a promise of peace and annuities that were to be supplied for 50 years. The treaty resulted in some gains but friction continued from tribes who were attracted to the game in the region and by wagon trains of gold seekers making their way to the California or other gold fields. The Crow were busy protecting their territorial boundaries.

Continued conflict in the region led the U.S. government to propose the Fort Laramie Treaty of 1868, which provided territories for individual tribes and closed the Bozeman trail and its forts. In this treaty, the Crow lost lands north of Yellowstone, south of the Montana territorial border and east of the 107th Meridian.

In 1869, the U.S. government established the Crow Agency near present-day Livingston, Montana. Conditions became sufficiently bad on the reservation that by 1872 the River Crow returned to their Missouri River hunting grounds while the Mountain Crow attempted farming on the reservation. In 1876, the Crow joined the U.S. in a war against the Sioux, Cheyenne and Arapaho.

The Crow struggled against tradition and the elements to develop farming on the reservation and at times obtained permission to leave the reservation to hunt. White settlers and miners continued to place pressure on the Crow lands. The Crow ceded the western boundaries of their land, one-quarter of their reservation, in the How-How Treaty of 1882 in exchange for houses and livestock. In the 1891 Act, the Crow ceded the western third of their reservation and in 1905 more land was ceded.

In the Crow perception of the world there is not a clear distinction between the western perception of spiritual and physical. All things in the universe are living entities: animals, plants, forces of nature, topographic features. The Supreme Force (First Maker) designed the universe and the Crow show their respect for these

blessings through their daily life (customs, traditions and practices). First Maker instilled the universe with baxpe or spiritualness. They maintain an intimate personal relationship with all things in the world around them and the spiritualness that they possess. By treating all things in a respectful fashion, the Crow can continue to survive.

The Crow historical perspective sees time as interlinked so that there is an intimate relationship between the individual and the past. The past (tradition or time) provides the template for the appropriate way to live. The Crow live in constant presence with the past that truly transcends the western concept of time. There are five qualities of time; sacred time, ancient Indian time, historic time, the present and the future, which have some sequential qualities but for the Crow the spiritualness of these times is most important.

In this world perception many landscapes and places are sacred. They are sacred because they represent why and how things are done. Sacred sites include cultural material scatters, petroglyphs, tipi rings, homesteads, burial areas, cairns, communal kills, fasting beds, medicine lodges, rock art, stone rings and settlements. Sacred locations and places include water (springs and rivers), spirit homes (springs, rivers, hills and mountains), landscapes (mountains and topographic features), plant and animal procurement areas, fossil areas and mineral locations.

Geology and Minerals

The reservation contains a varied geology, as does the state of Montana (see earlier Geology and Minerals description). Of particular interest to this SEIS are the deposits of subbituminous coal within the reservation. The known coal occurrences in the Powder River Basin are generally located in the Paleocene Fort Union Formation. Coal on the reservation is produced primarily from nine coal beds:

1. Roland: Top of Tongue River Member; average thickness 9 feet; resources 0.3 billion short tons; ranges in calorific value from 7,021 to 9,114 BTU, the sulfur content is 0.2 to 0.7 percent and ash content 3.8 to 9.7 percent.

2. Smith: Tongue River Member; average thickness 7 feet; resources 0.3 billion short tons; ranges in calorific value from 7,607 to 8,272 BTU, the sulfur content is 0.6 to 1.0 percent and ash content 6.8 to 30.2 percent.

3. Anderson: Tongue River Member; average thickness 20 feet; resources 1.9 billion short tons; ranges in calorific value from 8,705 to 9,850 BTU, the sulfur content is 0.2 to 0.6 percent and ash content 2.9 to 6.2 percent.

4. Dietz: Tongue River Member; two coal beds; average thickness 35 feet; resources 5.6 billion short tons; ranges in calorific value from 6,019 to 9,373 BTU, the sulfur content is 0.3 to 0.4 percent and ash content 2.9 to 6.3 percent.

5. Canyon: Tongue River Member; average thickness 20 feet; resources 3.7 billion short tons; ranges in calorific value from 8,446 to 9,113 BTU, the sulfur content is 0.2 to 0.3 percent and ash content 3.2 to 10.7 percent.

6. Wall: Tongue River Member; average thickness 20 feet; resources 4.9 billion short tons; ranges in calorific value from 7,637 to 10,079 BTU, the sulfur content is 0.1 to 1.1 percent and ash content 3.1 to 12.5 percent.

7. Rosebud: Tongue River Member; average thickness 10 feet; resources 0.1 billion short tons; ranges in calorific value from 7,810 to 9,090 BTU, the sulfur content is 0.5 to 1.1 percent and ash content 8.1 to 12.6 percent.

8. McKay: Tongue River Member; average thickness 10 feet; resources 0.1 billion short tons.

9. Robison: Tongue River Member; average thickness 10 feet; resources 0.05 billion short tons.

The coals occur on the east side of the reservation in a 12 to 15 mile wide area, extending from the Wyoming border to the north border of the reservation.

These deposits have been estimated to contain 17.1 billion short tons of coal of which 16.1 billion tons may be prospective for CBNG development (Crow Tribe 2002). The aggregate thickness of these coals may be as thick as 100 feet in places (Admin. Report BIA-7, 1975). Geology and stratigraphy of the Planning Area are discussed at length in the Minerals Appendix.

The Absaloka coal mine produces coal from a strip of land the Crow Tribe ceded in 1904 to the U.S. for settlement by non-Indians. The U.S. holds rights to minerals underlying the ceded strip in trust for the tribe. In 1972, with the approval of the Department of the Interior and pursuant to the Indian Mineral Leasing Act of 1938, Westmoreland Resources, Inc., a non-Indian company, entered into a mining lease with the tribe for coal underlying the ceded strip (U.S. Supreme Court May 1998). Today the Absaloka mine annually produces an average of 5,500,000 short tons of coal from its 5,400-acre permitted facility.

The reservation also includes the Soap Creek, Lodge Grass, Gray Blanket, Hardin and Ash Creek oil and gas fields. There have been 172 conventional wells drilled to date on the reservation. Production occurs from the Fort

Union, Shannon, Tensleep, Amsden and Madison formations within the reservation (Crow Tribe 2002).

Protecting the Indian lessors from loss of royalty as a result of conventional oil and gas drainage is a prime responsibility of the BLM. Under the terms of both federal and Indian leases, the lessee has the obligation to protect the leased land from drainage by drilling and producing any well(s) that are necessary to protect the lease from drainage, or in lieu thereof and with the consent of the authorized officer, by paying compensatory royalty. Drainage analysis, on the basis of a production screen or other criteria, is required by BLM document H-3160-2, Drainage Protection Guidelines Instruction Memorandum. Under this memorandum, federal or Indian mineral interests determined to be in danger of drainage will be subject to geologic, engineering and economic analyses in order to define the presence and magnitude of resource drainage.

Hydrology

Hydrological resources on the reservation consist of surface water flow from several rivers and their associated tributaries and the production of groundwater from a variety of geological formations. A detailed explanation of the regional hydrology including that of the reservations is included in an earlier section of this chapter under Hydrology.

The Crow Indian Reservation is within the Billings RMP area. The three major drainages on the Crow Reservation are the Bighorn River, Little Bighorn River and Pryor Creek (Crow Tribe 2002). Three additional drainage basins partially headwatered on the reservation are Bighorn Lake (on the Bighorn River), the upper Tongue River and Rosebud Creek. Collectively, these drainages are part of the Yellowstone River Basin (Crow Tribe 2002).

Water quality in the rivers and streams on the reservation is reported to be generally good, with levels of dissolved solids naturally high (Crow Tribe 2002). Pollution problems (primarily high sediment and salinity levels) are primarily related to non-point source agricultural practices and return flows. Table WIL-2 in the Wildlife Appendix summarizes aquatic resources characteristics and resource values from the Montana State Library NRIS (2001) Internet database for several representative drainages on the Crow Reservation, including the upper and lower Bighorn River, the Little Bighorn River, the upper Tongue River and Rosebud Creek.

According to the 2004 303d list, several watersheds and impaired water bodies are adjacent to the Crow Reservation. These include the Rosebud watershed which crosses a part of the Crow Reservation; The Lower Bighorn watershed includes a large part of the Crow Reservation, which contacts both impaired portions of the Bighorn River; and the Little Bighorn watershed that includes a large part of the Crow Reservation, but no water bodies are determined to be impaired on the 2004 303d list.

Most streams experience an increase in concentrations of dissolved solids downstream because of irrigation return flow, increased base flow contributions and pollution from human activities. Water contributed as base flow water has been in contact with soil and rocks for long periods of time. It therefore contains larger concentrations of dissolved solids than surface runoff water (Crow Tribe 2002).

Surface water quality in the Little Bighorn River Basin is affected by high-quality Bighorn Mountain snowmelt, surface- and ground-water inflow and irrigation in Montana. As in most semi-arid areas, the concentration of dissolved materials in effluent streams generally increases with distance downstream. The total sediment load is large, ranging between 158 and 16,200 tons/day for the Little Bighorn below Pass Creek. Other than its high suspended sediment concentrations, water in the Little Bighorn River can be characterized as very good water that is suitable for most uses.

Snowmelt, ground- and surface-water inflow, geology and irrigation affect water quality in the creeks draining into the Tongue River. The chemical quality of these creeks is suitable for most uses, although the high hardness and alkalinity values might require treatment for some industrial uses. Again, water quality in these creeks degrades with increasing distance downstream. Based on an analysis for the referenced document, water in Squirrel Creek failed to meet the Secondary Drinking Water Standards for Total Dissolved Solids. Surface and groundwater inflows, as well as evaporation, degrade water quality in Rosebud Creek (Crow Tribe 2002).

The groundwater resources for the reservation are more diverse than to those described for the Powder River Basin in the previous Hydrology section of this chapter. The potential for groundwater resources underlies most of the Crow Reservation. The stratigraphy varies from Pre-Cambrian age granitic gneiss and schist in the Bighorn and Pryor mountains on the west to the Eocene deposits of the Wasatch Formation in the Wolf Mountains and Powder River Basin on the east. The pronounced geologic structures, semi-arid climate and sculptured terrain lead to highly varied, but often prolific, groundwater resources within the reservation. Regional aquifers located on the reservation include the following:

- Alluvial sand and gravel (Holocene)
- Terrace gravel (Pleistocene)
- Clinker deposits (Holocene, Pleistocene and Pliocene)

- Fort Union Formation (Paleocene)
- Fox Hills—Hell Creek sandstone (Upper Cretaceous)
- Eagle Sandstone (Upper Cretaceous)
- Parkman Sandstone (Upper Cretaceous)
- Pryor Conglomerate (Lower Cretaceous)
- Tensleep Formation (Pennsylvanian)
- Mission Canyon limestone of the Madison Group (Mississippian)
- Jefferson limestone (Ordovician)

Locally many other water-bearing zones may occur in isolated sandstone and siltstone beds and in fractured bedrock of any type (Crow Tribe 2002). A total of 2,237 wells have been registered with the MBMG. The majority of the wells are producing at depths less than 200 feet bgs and only 30 wells have been drilled deeper than 700 feet bgs. The majority of the wells are used for stock water, irrigation and domestic consumption (Crow Tribe 2002).

Groundwater quality under the reservation is summarized on Table 3-19.

Land Use and Realty

The Crow Reservation comprises approximately 9 percent of the land in the Planning Area. Of the approximately 1.5 million acres of tribal or allotted trust ownership, 68 percent is grazing rangeland, 12 percent is dry cropland, 3 percent is irrigated cropland, 1 percent is forested, 1 percent is wildland and 1 percent is developed area (Crow Tribe 2002). The Crow maintain almost 1.2 million acres of leased grazing lands, 150,000 acres leased dry-farming land and the nearly 30,000 acres leased irrigated farming land. Most lands are leased to large non-Indian interests by Allottees (U.S. Department of Commerce 1996).

The principal communities located on the Crow Reservation are as follows:

- Crow Agency—The Crow Tribal Government administration, the BIA and the Crow Hospital are located in the town of Crow Agency. There are approximately 3,245 Indian people residing in Crow Agency. A 16-bed hospital is located in Hardin, Montana, approximately 12 miles from Crow Agency. Two larger hospitals (250+ bed facilities) are located in Billings, Montana, 65 miles from Crow Agency. Billings is recognized as the major medical referral center for east-central Montana and northern Wyoming.

- Lodge Grass—The Lodge Grass is located approximately 22 miles south of Crow Agency and houses the Lodge Grass Health Center. Approximately 2,125 Indian people live in Lodge Grass.

TABLE 3-19

GROUNDWATER SODIUM ADSORPTION RATIO AND TOTAL DISSOLVED SOLIDS VALUES CROW INDIAN RESERVATION

Study Area	Formation	# Wells	Avg. SAR	SAR Range	Avg. TDS	TDS Range
Hardin 3 (NE)	Fort Union	22/2	4.7/43	55 – 0.4		
		36			1,794	405 – 4,672
	Quaternary	16	4.36	32 – 0.1	1,487	184 – 3,920
	Judith River	1		0.7		405
Hardin 4 (NW)	Quaternary	15	7.3	15 – 1	2,859	6,570 – 724
	Unknown	9	9	47 – 0.1	2,223	4,770 – 606
	Pre Judith River	2		0.5 – 0.4		3,170 – 2790
Hardin 5 (SW)	Quaternary	6	4	7 – 2	2,871	806 – 5,850
	Unknown	1		12		614
	Pre Judith River	2		52 – 0.4		4,990 – 2,065
Hardin 6 (SE)	Quaternary	14	1.9	11 – 0.7	1,318	7,720 – 400
	Judith River	3	54	64 – 47	1,107	1180 – 1,000
	Pre Judith River	3	50	82 – 23	3,126	8,060 – 452

Source: Miller et al. 1977, Crow Tribe 2002.
SAR is sodium adsorption ratio
TDS is total dissolved solids
Avg. is average

- Pryor—The Pryor Health Station is located here, approximately 69 miles northwest of Crow Agency. The Indian population of Pryor is estimated at 1,018.

- Wyola—This community is located approximately 13 miles from Lodge Grass and approximately 35 miles from Crow Agency. There are nearly 450 Indian people residing in Wyola.

Paleontological Resources

The Crow Reservation includes bedrock deposited during the Late Cretaceous to Early Tertiary time. These geologic formations were deposited in a broad, epicontinental seaway that extended through the western interior from the Arctic Ocean to the Gulf of Mexico during Late Cretaceous. The cyclic transgression and regression of the shallow seas and the final withdrawal during the Late Tertiary time resulted in a wide variety of environments of deposition. The depositional environments of marine and nonmarine sedimentation resulted in a rich fossil record including dinosaurs, mammals and other vertebrate and paleobotanical remains. The great abundance, diversity and generally excellent fossil preservation in the region present significant scientific research opportunities.

Detailed paleontological field surveys have not been conducted within the reservation. The formations listed below are known to yield paleontological material across Montana:

- Wasatch—has yielded mammals and plant fossils
- Fort Union—various non-marine animals and plants
- Fox Hills-Hell Creek—marine and non-marine animals including dinosaurs
- Bearpaw, Judith River, Claggett—marine animals and dinosaurs
- Morrison—dinosaurs and early mammals
- Swift and Rierdon—marine invertebrates
- Madison—marine invertebrates
- Cloverly Formation-early cretaceous fossils

Site-specific studies would need to be conducted prior to bedrock disturbance (Crow Tribe 2002).

Recreation

The Crow Indian Reservation is a large contiguous tract of land that provides dispersed outdoor recreation for tribal members. This includes hunting, fishing, picnicking, camping, hiking, horseback riding, snowmobiling and off-road vehicle use. Yellowtail Dam at Bighorn Canyon provides some of the finest fishing, water sports and camping in the state of Montana. Non-tribal members are not allowed to hunt on the reservation except for spouses of tribal members. Crow Agency recreational facilities are provided at three city parks, the school gymnasium, playground areas and the Crow Tribal Fairgrounds. Within the town of Lodge Grass on the reservation, there is a city park with landscaped open space and picnic facilities. Outdoor sports and playground equipment are available on the school grounds in Lodge Grass.

The Crow Tribe hosts one of the largest powwows held in the U.S. The Crow Fair takes place at the Crow Agency every August. There is spirited competition dancing, drumming and singing, as well as food and craft concessions. Crow Agency is also near the Battle of the Little Bighorn National Monument, a popular tourist site. Once each year the tribe does a brilliant re-enactment of the battle.

Soils

Soils in the reservation, just like soils in the surrounding area, are derived mainly from sedimentary bedrock and alluvium. The soils generally range from loams to clays, but are principally loams to silty clay loams. For more information on soil types, see the Soils Appendix.

Vegetation

The major native plant communities on Crow Lands include grass and shrub rangelands, forestlands, riparian areas and barren lands. These classifications are discussed in detail in the Vegetation section.

Rangelands on the reservations are mostly mixed grass prairie in the lowlands and mixed grass, ponderosa pine (*Pinus ponderosa*), Rocky Mountain juniper (*Juniperus scopulorum*) and Douglas fir (*Pseudostuga menziesii*) in foothill and mountain areas (Crow Tribe et al. 1997). Predominant rangeland species are bluebunch wheatgrass (*Pseudoroegneria/Agropyron spicata*), western wheatgrass (*Pascopynum smithii*), Idaho fescue (*Festuca idahoensis*), green needlegrass (*Stipa viridula*), needle and thread (*Stipa comata*), little bluestem (*Schizachyrium scoparium*), blue grama (*Bouteloua gracilis*) and sideoats grama (*B. curtipendula*). Other species of grass such as switchgrass (*Panicum virgatum*), Indian ricegrass (*Oryzopsis hymenoides*), big bluestem (*Andropogon gerardii*), prairie sandreed (*Calamovilfa longifolia*) and little bluestem are found on sandy sites.

Riparian species include prairie cordgrass, rushes and sedges. Forbs include lupine (*Lupinus* spp.), Hood's phlox (*Phlox hoodii*), green sagewort (*Artemisia campestris*), cudweed sagewort (*Artemisia ludoviciana*), fringed sagewort (*Artemisia frigida*), white loco (*Oxytropis lambertii*), povertyweed (*Monolepis* sp.) and scurf pea (*Psoralea tenuiflora*). Shrubs include big sagebrush (*Artemisia tridentata*), rabbitbrush (*Chysothamnus* spp.), snowberry (*Symphoricarpus albus*), greasewood (*Sarcobatus vermiculatus*) and snakeweed (*Gutierrezia sarothrae*) (Crow Tribe 2002).

Forestlands on tribal lands are mainly in the higher elevations in the Wolf Mountains, Bighorn Mountains and Pryor Mountains. Ponderosa pine is the dominant tree with aspen (*Populus tremuloides*) stands also present in some drainages.

Riparian zones are the smallest land cover type on the Crow Reservation (Crow Tribe et al. 1997). Dominant vegetation in these linear strands along rivers and streams are cottonwood (*Populus* spp.), boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), sandbar willow (*Salix interior*) and American plum (*Prunus americana*). These areas can also have a thick understory of shrubs, if livestock access to them is limited.

Special Status Species

Four plant species of special concern to the state of Montana that occur on tribal lands are sweetwater milkvetch (*Astragalus areetioides*), Joe Pye weed (*Eupatorium maculatum* var. *bruneri*), Purpus' sullivantia (*Sullivantia hapemanii* var. *hapemanii*) and tall centaury (*Centaurium exaltatum*). See the Vegetation Appendix Table VEG-6 for habitat information for these species.

There are certain other plant species that are sacred to the Crow Nation for traditional and/or therapeutic reasons. These special status plants are in addition to those listed under the Vegetation section for the total project area.

Noxious weeds are similar on the Crow Reservation to the rest of the project area and are discussed under the main Vegetation section in this SEIS.

Wildlife

According to the Crow Indian Reservation Natural, Socio-Economic and Cultural Resources Assessment and Conditions Report there are an estimated 79 species of mammals, 260 species of birds, five species of amphibians and 14 species of reptiles found on the Crow Reservation some time during the year. Big game species include pronghorn antelope, elk, white-tailed deer, buffalo and black bear. Small game animals include white-tailed jackrabbit, snowshoe hare and mountain cottontail. Upland game birds include Merriam's turkey, mourning dove, blue grouse, ruffed grouse, sharp-tailed grouse, sage-grouse, chukar partridge, ring-necked pheasant and gray partridge.

Fur bearers on the reservation include: beaver, muskrat, lynx, bobcat, raccoon, red fox, coyote, badger, striped skunk, western spotted skunk, mink, ermine and long tailed weasel. Many species of rodents are found on the reservation, of these the prairie dog is the most important because of its relationship as prey.

Several raptorial birds are common throughout the area and nest on the reservation. Some of these include the American kestrel, northern harrier, red-tailed hawk, bald eagle and golden eagle. Prairie falcons may also reside on the reservation but are considered uncommon.

Special Status Species

Five endangered species may at times be found on the reservation (Crow Tribe of Indians 2002). These are the grizzly bear, gray wolf, black-footed ferret, whooping crane and peregrine falcon. It is unlikely that any of the endangered mammals reside on the reservation. Whooping cranes and peregrine falcons may migrate through the Crow Reservation in the spring and fall months.

Aquatic Resources

The Crow Tribe (2002) reported that 19 species of fish occur on the Crow Reservation at some time during the year. The tribe also stated that Bighorn Lake (impounded by Yellowtail Dam), which begins in Wyoming and runs into the Crow Reservation in Montana, provides some of the finest fishing in the state. The tribe noted that a nationally famous fishery for huge rainbow trout and brown trout occurs in a 12-mile reach of the Bighorn River downstream of Yellowtail Dam.

Water discharged from Bighorn Lake to the river is cool and nutrient-rich and supports a blue-ribbon trout fishery reported to be the premier tail-water fishery in North America (Crow Tribe 2002). Table WIL-3 (in the Wildlife Appendix) summarizes fish species composition and abundance information from the Montana State Library Natural Resource Information System (Montana NRIS 2001) Internet data base for the same representative drainages on the Crow Reservation that were listed in the preceding paragraph for Table WIL-2 (in the Wildlife Appendix). In addition to these drainages, Pryor Creek in the western portion of the Crow Reservation provides some habitat for rainbow, Yellowstone cutthroat and brook trout and is rated as having a moderate fisheries resource value (Montana NRIS 2001).

Northern Cheyenne Reservation

Much of the information in this section was summarized from The Northern Cheyenne Tribe and Its Reservation: A Report to the U.S. Bureau of Land Management and the state of Montana Department of Natural Resources and Conservation (Northern Cheyenne Tribe April 2002). Readers should refer to that document for more detailed information. This document can be downloaded from the BLM web site at http://www.mt.blm.gov/mcfo/cbm/eis/NCheyenneNarrativeReport/index.html.

The Northern Cheyenne Indian Reservation occupies about 445,000 acres in eastern Big Horn and southern Rosebud counties, Montana. U.S. Highway 212 provides access. The reservation covers nearly 695 square miles and is bordered on the east by the Tongue River and on the west by the Crow Reservation. According to the BIA Realty Office, the tribe has 442,193 trust acres and 444,000 of surface and mineral estate lands. There are 138,211 individual allotted acres on the reservation.

President Arthur issued an Executive Order establishing the reservation in November of 1884 with a land trust of about 271,000 acres. In 1900, President McKinley issued a second Executive Order on behalf of the Northern Cheyenne that shifted the eastern boundary to the Tongue River, expanding the reservation to its current size. The topography deviates from low, grass-covered hills to high, steep outcroppings and narrow valleys. Elevations range from approximately 3,000 to 5,000 feet.

Tribal Government

The tribe ratified a constitution and bylaws in 1936 according to Indian Reorganization Act rules. The Tribal Constitution was amended in 1960 and 1996. The 1996 amendment initiated a three branch system: Executive Branch, consisting of the Tribal President, Vice President, Secretary and Treasurer; Legislative Branch consisting of the Tribal Council and it committees and Judicial Branch consisting of the courts. The Tribal Council consists of 11 full-time members, a seat held by the Vice President, five seats each representing one of the districts (Ashland, Birney, Busby, Muddy and Lame Deer) and five seats allocated among the five districts based on the percentage of Tribal membership. The Tribal President presides over the Tribal Council. The Tribal Council powers include representative, proprietary, fiscal, police and economic.

In the Executive Branch, the Tribal President and Vice President are elected by the Tribal membership and the Tribal Council appoints the Secretary and Treasurer. The Tribal President oversees the Executive Branch and appoints persons to all Tribal Boards, commissions, departments and agencies (Culture Committee, Economic Development Committee, Enrollment Committee, Gaming Commission, Land Committee, St. Labre Task Force, Newsletter Committee, Grazing Board, Natural Resource Board, Housing Authority, Utilities Commission, TERO Commission, Board of Health, Ad Hoc Committee and Credit Committee) and oversees a host of tribal programs.

The reservation court system was updated in 1998 providing for the election of at least two full-time trained court judges and at least three part-time appellate judges appointed by the Tribal President. A Constitutional Court was established to review the constitutionality of Tribal Council ordinances and has the exclusive power to remove a Tribal judge.

Demographics

According to the 2000 Census, the population of the Northern Cheyenne Reservation (reservation) is 4,470 persons, of whom 4,029 are Native Americans. The Northern Cheyenne Tribe report indicates that this number likely underestimates the actual population. Although the Census does not provide estimates of undercounts, the report estimates the actual reservation population could be about 5,000, based on past Census adjustment methods. Tribal enrollment is 8,008 persons, of whom 4,343 live on or near the reservation.

Geographically, the Northern Cheyenne Reservation's most immediate social environment consists of Big Horn and Rosebud counties, the Crow Reservation on the west and Powder River County to the east. The reservation has a much higher population density than the surrounding counties. According to the 2000 Census, the reservation had 6.4 persons per square mile, several times greater than the surrounding counties, which had 1.4 persons per square mile. The age distribution on the reservation is more heavily weighted toward the young than the surrounding counties. The median age on the reservation is 22.7 years compared to an average of 39.2 years in the three surrounding counties.

According to the 1990 Census, the poverty rate on the reservation was 47 percent. This compares to an average poverty rate of 12 percent for the non-reservation portions of Rosebud and Powder River counties. Additional information on poverty rates, including rates calculated by the BIA, is provided in the Socioeconomics section of Chapter 3.

Social Organization

There is a housing shortage on the reservation. The Northern Cheyenne Report estimates that there are

about 1,200 housing units on the reservation to serve a population of about 5,000. As a result, most reservation housing is overcrowded and a number of tribal members commute from off-reservation housing to jobs on the reservation. Of the 1,200 housing units, about 800 are public housing managed by the Northern Cheyenne Housing Authority, about 20 units are employer-owned housing and about 300 units are privately owned. In addition, there are an unknown number of mobile homes and trailers. Overall, the housing on the reservation is in poor condition, due to a number of factors including age, poor construction and lack of financial resources to maintain it. A significant number of the housing units do not have regular electrical service.

The tribe operates two programs intended to address the housing situation on the reservation—the Northern Cheyenne Housing Authority, which is responsible for new public housing construction and renovation projects and the Housing Improvement Program, which provides funding for the renovation of private homes on the reservation.

The report provides a detailed description of public services and facilities, including utilities, education, social services, police, fire and medical services, employment and job training and transportation. A common theme with a number of the services is their inadequacy due to maintenance or capacity issues. A number of basic programs and services on the reservation are still administered by the federal government. The BIA is directly responsible for providing law enforcement services and also manages the reservation's forests and range lands. The BIA is responsible for the reservation's road network and oversees all real estate transactions.

Public schools are available for pre-school grades and K-12 in Lame Deer. Ashland houses the St. Labre Indian High School or students may decide to attend public high school in Colstrip, Montana. In Colstrip there are three public elementary schools, a middle school and a transportation system, which serves all grade levels. For college, students may choose to attend the Dull Knife Community College in Lame Deer. The institution offers several associate degrees and certified programs. Dull Knife Community College also offers courses on the Cheyenne language. Approximately 62 percent of the tribal members have a high school diploma and 5.6 percent have a Bachelor's Degree or higher.

Economics

The current economy is primarily based on livestock; individual tribal members own an estimated 12 to 15 thousand head of cattle, which are presently worth about $12 million on the open market. The tribe has approximately 27,000 acres of reservation lands presently under cultivation, the vast majority of which is dryland farming. This primarily entails hay, wheat, barley and small grains. Annual revenues generated by farming are estimated at about $2.5 million (U.S. Department of Commerce 1996).

In addition to this agricultural-based income, the tribe has developed several secondary routes of income including construction, timber sales, small business and casino gaming.

There are several skilled construction contractors and subcontractors amongst the tribe, one of which is reported to have a contract for construction of the new Community Center (the old one having burned down in 1989). Additionally, new tribal housing units are planned; tribally based contractors are bidding for this project. In general, the construction industry generates sizable employment and revenues for the tribe.

One third of the reservation or approximately 147,000 acres is composed of forested land, the majority of which is comprised of Ponderosa Pine forests. The commercially available portion of these forested lands is estimated at 70 percent. The tribe's sawmill was closed; since then, little if any timber has been sold. The Northern Cheyenne Pine Company is the lead forest product company using reservation timber resources.

There are currently 44 small businesses on the reservation, the majority Indian-owned. These businesses include laundromats, restaurants, gas stations, grocery stores, construction contractors, drilling companies, a lumber mill, a clothing designer and Indian arts and crafts outlets.

The tribe operates the Northern Cheyenne Bingo facility, a moderate-sized casino operation, offering bingo, pull tabs and video poker. The casino generates no net revenues for the tribe; however it employs a number of tribal members (letter from Northern Cheyenne Tribe dated October 18, 2005).

Additional Detail

The information that follows was summarized from a report by the Northern Cheyenne Tribe (April 2002). Readers should refer to that document for more detailed information.

According to the 1999 BIA Labor Force Report, only 29 percent of the potential 2,437-person labor force on the reservation is employed; the unemployment rate is 71 percent. For further discussion, see Table 3-31 and the text in the Social and Economic Values section under the heading of Unemployment.

A detailed discussion of the history of reservation employment and economics in relation to energy

production is provided in the Northern Cheyenne report. The report reviews the energy development between 1970 and 1990 and the associated rise and then fall of wages, employment and property taxes in the reservation area. The primary local economic impact of the mineral development during that time was in the creation of jobs and payment of wages, in addition to state and local taxes collected on mineral extraction. Energy and extraction provided some of the highest-paying jobs available in Montana.

Despite the new wealth and jobs created, the energy boom from 1970 to 1990 generally did not support improved prosperity on the reservation. On the reservation, a number of indicators of economic health declined during this period. Reasons cited for this deterioration of economic conditions include lack of access by Northern Cheyenne to the high-paid energy jobs, limited local commercial infrastructure on the reservation and lack of access to the energy-related revenues to support public services and infrastructure on the reservation.

The federal government plays a major role in tribal economics. Direct federal funding in the form of grants, contracts and funding agreements and indirect costs recovery make up the lion's share of the tribe's total revenues and expenditures. Between 1976 and 1997, the Northern Cheyenne Tribe entered into contracts with the BIA assuming responsibility for more than 20 BIA programs with a total budget in fiscal year 2002 of $3.7 million. The tribe also enters into funding agreements with the Indian Health Service and federal housing, welfare and employment programs. In all, the tribe administers about 70 federal grants and programs with a combined value in fiscal year 2002 of about $21.3 million. In fiscal year 2002, federal funding for direct and indirect program expenditures is projected to exceed the tribe's general fund revenues by a factor of 10.

Sources of tribal government fiscal resources include the general fund, indirect cost reimbursement, fiduciary funds and special revenue funds. The general fund is used to finance the basic operations of tribal government. The fund is also used to provide matching funds for federal programs and to subsidize under-funded federal programs. General fund revenues are derived from income from tribal natural resources (primarily timber sales and grazing leases), earnings distributed from the permanent fund, interest on other funds and federal payments in lieu of taxes. Because the reservation tax base is limited, the tribe imposes no taxes and derives no revenues from taxation. The general fund budget for fiscal year 2002 is $2.03 million, which represents a 40 percent decline from 2001, primarily due to decreased earnings distribution from the permanent fund and declining income from natural resources. Tribal discretionary funds—those funds available to fund the operations of the tribal government and discretionary programs and services—are limited.

Air Quality

The air quality and climate of the Northern Cheyenne Reservation is similar to that of the regions described earlier in Chapter 3. The Northern Cheyenne Reservation is classified as a PSD Class I area. Additionally, the community of Lame Deer, Montana, is classified as a moderate PM_{10} nonattainment area.

The tribe is under contract with Pennsylvania Power and Light to maintain, calibrate and report data from three ambient air PSD stations. These stations are used to monitor SO_2, NO_2, wind speed and direction, precipitation, barometric pressure, solar radiation, temperature and dew point. Background data from two of these stations for the January 1999 through June 2000 period indicate the maximum hourly concentration for SO_2 was 0.021 ppm and for NO_2, 0.034 ppm. However, the annual averages remain very close to zero.

Particulate matter (PM_{10} and PM2.5) ambient air monitoring is conducted in the community of Lame Deer. No exceedances of the NAAQS were noted in the years 1999 to 2000. Daily PM_{10} values ranged from 1.6 ug/m^3 to 131.3 ug/m^3. The PM_{10}, 24-hour average "not to exceed" value is 150 ug/m^3.

The tribe is in the process of developing a Tribal Implementation Plan, which will allow for enforcement of Class I air quality standards.

The reservation is located in a part of Montana that has a moderate climate relative to its latitude. Snow rarely accrues for long periods of time because of the warm Chinook winds, which originate from the mountains in the West. This portion of Montana is also known for its "Indian Summers" which frequently extend into November. The mean annual temperature is 45.5°F with a summer high of 110°F and a winter low of -48°F. The bulk of the reservation varies from 12 to 18 inches annual precipitation, depending on the elevation.

Culture and History

The Cheyenne are believed to descend from the Algonquian language people in the Great Lakes region, what the Northern Cheyenne call the northern homelands (Notum'histah'o'omih'nah). Western scientists believe that during the 1400s and 1500s they migrated southward into the Missouri River and the Black Hills country. The Northern Cheyenne believe that they left the Great Lakes region about 1600 to avoid contact with encroaching Europeans. They farmed corn and squash and practiced subsistence

fishing and gathering and hunting small game. While in the Missouri River region they encountered a group of Suhtio and they later integrated their beliefs, traditions and customs into one culture.

After 1600 they adopted the horse and became reliant on large game hunting and following the buffalo herds. From around 1640 to 1830, the Cheyenne engaged in commerce with Europeans as part of the fur trade, encountering the Lewis and Clark expedition about 1804.

The first treaty with the U.S. government was signed by a small group of Cheyenne in 1825 (the Friendship Treaty). In the 1830s, the Cheyenne began to split into the Southern Cheyenne and the Northern Cheyenne, preferring to live close to their Lakota relatives in the Black Hills, Powder River, Yellowstone River and Tongue River regions.

European settlement, gold seekers and other Euroamerican activity increased in the region throughout the first half of the 1800s leading to increased conflict, between Native People and with Euroamericans. In an attempt to decrease conflict the U.S. government established military outposts and an Indian Agency in the Upper Platte River Valley. They convinced a number of Native nations to adopt the Fort Laramie Treaty of 1851, which assigned the Cheyenne and Arapaho to lands south of the North Platte River and north of the Arkansas River in present day Wyoming, Nebraska, Colorado and Kansas. However, some Cheyenne bands remained north of the South Platte River and became known as the Northern Cheyenne. The Northern Cheyenne continued to resist incursions into what they considered their territory. Tensions between Euroamericans and the Northern Cheyenne increased during the Civil War. The Colorado Volunteer Militia raided a peaceful Cheyenne Village culminating in the Sand Creek Massacre. From this point through the late 1870s, the Cheyenne were at war with the U.S. government. The Battle of the Little Bighorn is the most well-known incident of this long struggle.

There were many bands involved in these battles and struggles and their movements were complicated and read like any war story. The Cheyenne were eventually subdued and split into various groups. In 1881, all of the Northern Cheyenne were sent to Fort Keogh and were allowed, under the Indian Homestead Act of 1875, to move south near the Tongue River and along Rosebud and Muddy creeks. The Northern Cheyenne settled in the area practicing their traditional culture and making a livelihood practicing western farming and ranching.

Disputes arose between white ranchers and the Northern Cheyenne leading to a special investigation, the outcome of which was the establishment of the Northern Cheyenne Reservation in 1884. Disagreements over the reservation boundaries continued until 1900 when the current reservation boundaries were established.

The Northern Cheyenne are the people of The Morning Star. They are caretakers of the Sacred Buffalo Hat, a sacred covenant with *Maheo* (Creator). Life for the Northern Cheyenne is a holistic interrelationship of history, work, religion, language, sacred belongings, health, medicine and education. All of these work to maintain the environment and culture of the people. Their sacred ways, such as the Keeper of the Sacred Buffalo Hat Covenant greeting the grandfather morning star, maintain a connection to *Maheo* and the creative essence that caused the universe and life itself to exist. Ritual and diligence in daily life to follow tradition maintains the elemental arrangement of creation. In this arrangement, all elements of creation are like a family: Sun as Grandfather, Earth as Grandmother, Moon as Mother, Stars as Brothers and Sisters and to the four cardinal directions as the Sacred Spirit Helpers who watch over their way of life.

An excellent outline and illustration of the Cheyenne cosmology and interrelationships can be found in the report, The "Northern Cheyenne Tribe" and it's Reservation (2002), which illustrates the universe as a renewable cycle with spiritual essence in constant interaction. *Maheo*, spiritual essence, is contrasted with *Heestoz*, substance or matter. Both are necessary for the continuation of the universe. Maleness, associated with *Maheo*, is the highest point in the universe and femaleness, associated with *Heestoz*, is the lowest point. The interaction of *Maheo*, Sun (Creator) and *Heh'voom*, earth (Grandmother) bring about all life. Between *Maheo* and *Heh'voom* are layers of space creating the structure of the universe is between. These layers are the Blue-Sky Space, the Nearer-Sky Space, the Atmosphere, the Earth Surface Dome and the Deep Earth. With this cosmology, birds and mountains are special sacred animals and places since they are closer to Blue-Sky Space containing the manifestation of *Maheo* (sun, moon, etc.). All things in this cosmology are animate.

Through sacred ways and ceremony, the Cheyenne believe that they can harness the spiritual essence as a power to benefit physical existence. If they do not practice traditional culture and beliefs to maintain the balance and cycle, the spiritual essence will not be available to benefit them or maintain the earth system.

With these belief systems natural resources become culturally and spiritually important, particularly water (with living spirits), plants (considered to be relatives), animals (also relatives), great birds (messengers to the spirits in Blue-Sky Space) and fossil and mineral sources (used in ceremony). Cultural resources such as

burials, ceremonial sites (fasting locations, vision quest sites, sweet lodges and memorials), homes (tipi rings, historic depressions, foundations and cabins), community and commercial reservation-era sites, military and exploration-related sites and prehistoric sites (lithic scatters, cairns and petroglyphs) are considered sacred to the Northern Cheyenne.

Traditional Cultural Properties

The Northern Cheyenne have expressed concern regarding off-reservation TCPs and they have identified numerous such sites. These TCP sites are held as sacred or of high importance to the tribe. Two particular sites mentioned at tribal consultation meetings and in tribal correspondence are the Rosebud and Wolf Mountain Battlefields. The Northern Cheyenne Tribe voiced concern over Northern Cheyenne homestead sites in the Tongue River valley.

The Rosebud Battlefield is the site of the June 17, 1876, battle between the Sioux and Cheyenne Indians and General George Crook's cavalry and infantry. One of the biggest Indian battles ever waged in the United States, it set the stage for the Indian victory eight days later at the Little Bighorn against Lt. Col. George A. Custer. The battle ranged over 10 square miles and involved 2,500 combatants. General George Crook's Big Horn and Yellowstone expedition force had 1,000 men and there were 1,500 Sioux and Cheyenne warriors. MFWP has a final management plan for the battlefield available.

In 1972, the Montana Department of Fish Wildlife and Parks purchased the ranch from the Kobold family and it became a state park. The Rosebud Battlefield is on the list of National Register of Historic Places.

The Wolf Mountain Battlefield is located on the east side of the Tongue River, beneath Pyramid Butte, a spur of the Wolf Mountains. The battle fought at this site climaxed Col. Nelson A. Miles' winter drive of 1876 and 1877. He pursued the Sioux under Crazy Horse, who had defeated the Custer command the preceding summer on the Little Bighorn. In October, Miles captured and sent 2,000 Sioux and Cheyenne back to the reservation. On January 7, 1877, Miles camped beside the Tongue River on the southern flank of the Wolf Mountains. The next morning, Crazy Horse and 800 braves made a surprise attack. Miles, his howitzers disguised as wagons, repulsed the attack. The Indians took refuge on bluffs overlooking the camp. When the troops assaulted the bluffs, the warriors withdrew under cover of a snowstorm. Many of the warriors surrendered with Crazy Horse and

Dull Knife's Cheyenne in the spring at Fort Robinson, Nebraska. Today a gravel road bridges the river from the west, crosses the valley where Miles camped, ascends the bluffs just south of Pyramid Butte (the final Indian position) and continues toward the town of Birney. Except for the road, the site has remained unchanged since 1877.

Geology and Minerals

The reservation contains a varied geology, as does the state of Montana (see earlier Geology and Minerals description). Of particular interest are the deposits of subbituminous coal within the reservation. The known coal occurrences in the Powder River Basin are generally located in the Paleocene Fort Union Formation. The coals on the reservation are known to be beneath the entire reservation and are estimated to contain 23 billion tons of coal of which 16.3 billion tons may be prospective for CBNG development (Admin Report BIA-3 1975). Five CBNG wells have been drilled prior to 1989 on the reservation with modest results (Northern Cheyenne Tribe 2002). In 1991, the tribe drilled and tested two CBNG exploratory wells (Northern Cheyenne Tribe 2002). Geology and stratigraphy of the Planning Area are discussed at length in Chapter 3, Geology and Minerals and in the Minerals Appendix.

The reservation does not have any known oil or gas fields. Twenty conventional wells have been drilled to date. Additionally, Atlantic Richfield (ARCO) has explored for oil and gas reserves on tribal lands but this data has not been released to state or federal agencies.

Non-metallic mineral resources on the reservation include bentonite, building and ornamental stone, claystone and shale, clinker and gravel (Northern Cheyenne Tribe 2002).

Protecting the Indian lessors from loss of royalty as a result of conventional oil and gas drainage is a prime responsibility of the BLM. Under the terms of both federal and Indian leases, the lessee has the obligation to protect the leased land from drainage by drilling and producing any well(s) that is necessary to protect the lease from drainage or, in lieu thereof and with the consent of the authorized officer, by paying compensatory royalty. Drainage analysis, on the basis of a production screen or other criteria, is required by BLM Handbook H-3160-2, Drainage Protection Guidelines. Federal or Indian mineral interests determined to be in danger of drainage are subject to geologic, engineering and economic analyses in order to define the presence and magnitude of resource drainage.

Hydrology

Hydrological resources on the reservation consist of surface water flow from the Rosebud Creek and the Tongue River and their associated tributaries and the

production of groundwater from a variety of geological formations.

Surface Water

Surface water on the reservation is contained in the Rosebud and Tongue River watersheds. These two watersheds support natural flows as summarized in Tables 3-20 and 3-21.

These two watersheds contain water resources of variable quality as described in the Water Resources Technical Report (ALL 2001b). Table 3-22 summarizes the long-term average water quality for the Tongue River watershed.

According to the 2004 state of Montana 303(d) list, Rosebud Creek is listed as being impaired immediately downstream of the northern reservation boundary. The probable causes identified on the 303(d) list are nutrients and "other," with the probable sources being dam construction and hydro-modification. No other impaired stream segments are located next to the reservation.

Groundwater

The groundwater resources of the reservation are similar to those described for the Powder River Basin in the previous Hydrology section of this chapter. Formations of importance to the groundwater resources of the reservation include the Madison Group of Mississippian age; the Fox Hills Sandstone and Hell Creek Formation of Cretaceous age; the Fort Union Formation of Tertiary age and the valley fill-alluvium of Quaternary age. The geologic formations and associated aquifers are discussed below. (Northern Cheyenne Tribe, 2002).

TABLE 3-20

AVERAGE ANNUAL GAGE AND ESTIMATED NATURAL FLOWS FOR THE TONGUE RIVER NEAR THE NORTHERN CHEYENNE RESERVATION (STUDY PERIOD 1940-1982, HKM 1983)

Location	Flow Type	Acre-Feet/Year
Tongue River at Tongue River Dam	Gage Flow	332,907 (St. Dev. = 112,406)
	Est. Natural Flow	421,238 (St. Dev. = 102,464)
Southern Boundary of Reservation	Est. Natural Flow	439,253 (St. Dev. = 106,154)
Northern Boundary of Reservation	Est. Natural Flow	455,161 (St. Dev. = 103,255)
Tongue River at Brandenburg Bridge	Gage Flow	362,614 (St. Dev. = 152,288)
	Est. Natural Flow	461,019 (St. Dev. = 104,352)

Source: Northern Cheyenne Tribe 2002.

TABLE 3-21

AVERAGE ESTIMATED NATURAL FLOWS FOR ROSEBUD CREEK, NORTHERN CHEYENNE RESERVATION (STUDY PERIOD 1939-1981)

Estimated Natural Flow at Location	Acre-Feet/Year
Rosebud Creek at Southern Boundary	11,818 (St. Dev. = 6,417)
Rosebud Creek neat Colstrip, Near Northern Boundary	26,727 (St. Dev. = 14,172)
Rosebud Creek near Mouth, Near Rosebud	27,297 (St. Dev. = 18,439

Source: HKM, RCB Hydrology 1982, Northern Cheyenne Tribe 2002.

TABLE 3-22

COMPARISON OF PREVIOUSLY CITED WATER-QUALITY PARAMETERS WITH LONG-TERM AVERAGE FIGURES, TONGUE RIVER AT STATE LINE

Data Source	Range	Sulfate (mg/l)	Dissolved Magnesium (mg/l)	EC (μS/cm)	SAR	Boron (μg/l)
HKM (1972)	High	500	50	1,100	2.0	0.38
	Low			230		
USGS (1985-1999 average)	Mo. Average High	180	45	699	0.67[1]	<1
	Mo. Average Low	30	10	299		

[1]SAR = 0.67 reflects published USGS data for water year 1997 as parameter 00931. SAR is not included in the data set available on USGS website (Northern Cheyenne Tribe 2002).

Madison Group

The Madison Group is divided into the Lodgepole Limestone at the base, the Mission Canyon Limestone and the Charles Formation at the top. The Madison Group is estimated to average around 1,100 feet thick within the reservation and the depth to the top is estimated to range between 7,200 and 9,100 feet below land surface. The aquifer contained within the Madison Group reportedly consists of extensive limestone and dolomite with shale, evaporate and cherty zones. Yields from Madison wells in the area range from 94 gpm immediately NW of the reservation to a reported 2,382 gpm from a flowing well approximately 90 miles NW of the reservation. Better porosity and permeability in the Madison aquifer are mainly associated with oolitic to fragmental limestone and with coarsely crystalline dolomite in the lower part. Solution and collapse breccias occur in the outcrops off the reservation; the extent of these features in the subsurface within the reservation is unknown.

Fox Hills Sandstone

The Fox Hills Sandstone, in the central Powder River Basin east of the reservation, is a sequence of marine and continental sandstone and shale 20 to 200 feet thick. Limited information available from oil and gas test holes on the reservation indicates the thickness of this unit to range from 65 to 760 feet. Depth to the top of the Fox Hills in the reservation is estimated to range between 2,200 and 3,500 feet. The most extensively used aquifer in the Central Powder River Basin is called the Fox Hills-Lower Hell Creek aquifer and it consists of the Fox Hills Sandstone and the overlying lower part of the Hell Creek Formation. Well yields from the Fox Hills-Lower Hell Creek aquifer range from 0.5 to 20 gpm and commonly are about 5 gpm. Yields of as much as 200 gpm to industrial wells have been reported (Slagle et al. 1985).

Hell Creek Formation

The Hell Creek Formation consists of sandstones, interbedded shales and siltstones. Available data indicates this unit underlies the entire reservation with a thickness of between 600 and 650 feet. Depth to the top of the Hell Creek formation within the reservation is estimated to be greater than 600 feet. Only one well is known to be completed in the Hell Creek formation near the reservation. It was drilled in 1959 for Saint Labre Mission to a total depth of 980 feet. At the time the well was constructed, it was under artesian pressure and flowed at the land surface at a rate of 60 gpm.

Fort Union Formation

The Fort Union Formation consists of the Tullock, Lebo Shale and Tongue River Members. The total thickness of this formation within the reservation is estimated to range from 1,800 to 2,200 feet. The formation dips to the southeast at 1 to 2 degrees regionally.

Tullock Member

The Tullock Member of the Fort Union Formation is estimated to range between 100 and 250 feet thick on the reservation and consists of sandstone, coal and shale beds. This unit is not a known source of water on the reservation. Yields to wells completed off the reservation in the Tullock Member range from about 0.3 to 40 gpm and generally are about 15 gpm (Slagle et al. 1985).

Lebo Shale Member

The Lebo Shale Member of the Fort Union Formation consists of dark shale and reportedly contains some lignite beds but no coal. The thickness of this unit on the reservation is estimated to range between 100 and 300 feet. It is not a known source of water.

Tongue River Member

The Tongue River Member of the Fort Union Formation is the major source of water withdrawn from wells in the northern Powder River Basin (Slagle 1985). It is the most reliable and shallow aquifer underlying most of the area, including the Northern Cheyenne Reservation. There are more than 100 springs on the Northern Cheyenne Reservation. Many of these springs emanate from the base of a clinker-shale contact, very commonly in the Tongue River Member of the Fort Union Formation. Depending on the geologic location of the spring, yield can range from 1 to 92 gpm.

Lower Tongue River Aquifer

The Lower Tongue River aquifer consists of the sandstone, siltstone, shale, coal and clinker beds from the base of the Robinson coal seam to the shale beneath the Knobloch coal seam. The aquifer is generally around 500 feet thick, except in the major stream valleys where erosion has reduced the total thickness to between 300 and 450 feet thick. Drill hole data indicates beds of permeable sandstone and shale are discontinuous and occur primarily as lenses grading from shale to siltstones.

Several wells are known to be completed in the Lower Tongue River aquifer. Most of these domestic wells were completed in sandstone and yield between 8 and 20 gpm. Wells in Muddy Cluster and Busby finished in the sandstone reportedly yield 18 and 50 gpm, respectively.

Upper Tongue River Aquifer

The Tongue River Member is Tertiary in age and crops out at the surface over much of the reservation. The Upper Tongue River aquifer consists of the sandstone and clinker beds within the Knobloch, Wall and Anderson systems.

Knobloch System

This unit consists of sandstone, siltstone, shale, coal and clinker. The Knobloch system ranges from 0 to 366 feet in thickness. Depth to the top of the unit is generally less than 1,100 feet depending on location on the reservation. Many wells and springs obtain groundwater from this system. Yields of wells completed in the sandstone generally range between 8 and 10 gpm. Wells completed in the Knobloch clinker yield as much as 50 gpm. Springs associated with sandstone and coal outcrops of the Knobloch generally flow less than 3 gpm.

Wall System

The Wall system consists of sandstone, siltstone, shale, coal and clinker. It ranges in thickness from 0 to 790 feet. Beds of permeable sandstone are discontinuous and occur primarily as lenses between shale and siltstone layers. Depth to the top of the unit is generally less than 300 feet depending on location on the reservation. The Wall coal seam and its related clinker form the thickest most continuous unit of this system, ranging from 20 to 40 feet. The Canyon coal seam, within the Wall system, also forms a relatively thick and continuous unit (20 to 30 feet). Several wells and springs derive water from the Wall system. Well yield ranges from 10 to 15 gpm. Springs flow from sandstone, siltstone and clinker units and vary from 1 to 25 gpm within the reservation.

Anderson System

This system consists of fine sandstone, siltstone, shale, coal and clinker ranging in thickness from 0 to 300 feet. The Anderson coal seam and its related clinker deposits form the thickest single unit within this system. Thickness of the Anderson coal varies from 30 to 60 feet but thins to the west. Massive clinker related to the burning of the Anderson and thin upper coal seams is reported to vary from 100 to 200 feet in the central and northern portions of the reservation.

Several wells and springs are known to derive water from the Anderson aquifer system. No production data is available as all wells completed before 1977 were monitoring wells. Springs associated with sandstone and siltstone units above the Anderson coal seam generally yield less than 1 gpm within the reservation.

Valley Fill-Alluvium

Valley fill-alluvium is found underlying and bordering the principal drainages within the reservation. These deposits include the Rosebud Creek, Muddy Creek, Lame Deer Creek and Tongue River alluvium.

Rosebud Creek Alluvium

The Rosebud Creek alluvium consists of clay, silt, sand, gravel and clinker fragments. Silts and clays are usually found as thin beds separating sand and gravel deposits. According to driller's logs, the Rosebud Creek alluvium ranges in thickness from 6 to 110 feet, with an average thickness of 52 feet. An aquifer test performed in 1978 indicated an average transmissivity

of 6,243 ft^2/d for a saturated thickness of approximately 76 feet. This value is considered to be representative of the valley fill alluvium immediately adjacent to Rosebud Creek between the southern reservation boundary and Busby. For wells completed in the Rosebud Creek alluvium, yield ranges between 6 and 20 gpm.

Muddy Creek Alluvium

The Muddy Creek alluvium consists of a mixture of silt, sand, gravel and clinker fragments. Based on driller's logs, the thickness of these deposits range from 0 to 112 feet and average 52 feet thick. The average saturated thickness is 30 feet. Assuming the deposits are similar to the Rosebud Creek alluvium, a transmissivity of 2,463 ft^2/d is calculated. Several wells, known to be completed in the Muddy Creek alluvium, yield between 10 and 15 gpm for domestic supply.

Lame Deer Creek Alluvium

The Lame Deer Creek alluvium consists of silt, sand and relatively thick gravel and clinker wash as compared to that of Rosebud and Muddy Creek deposits. Driller's logs indicate that the thickness of this deposit ranges from 12 to 63 feet. Domestic wells completed in the Lame Deer Creek alluvium yield between 6 and 15 gpm.

Tongue River Alluvium

The Tongue River alluvium consists of sand and gravel-sized clinker fragments derived from the Tongue River Member of the Fort Union formation. The thickness of this deposit ranges from 34 to 100 feet and averages 66 feet (Northern Cheyenne Tribe 2002).

Groundwater Quality

A thorough evaluation of groundwater quality was performed by the Northern Cheyenne Research Project from 1973 through 1977 and published by HKM in 1983. The following descriptions are based on the data collected during that study period. The majority of water quality data on the reservation exists for the Fort Union and alluvial aquifers. Individual aquifers are discussed below (Northern Cheyenne Tribe 2002).

Fort Union Formation and Tongue River Member

Samples obtained from wells indicated water in these geologic units to be a mixed type with this dominant ions being sodium, magnesium, calcium, bicarbonate and sulfate. TDS concentration generally range from 232 to 3,774 mg/l in wells tapping sandstone, coal and clinker units. Water ranges from soft to very hard with calcium carbonate levels between 14 to 1,468 mg/l. Fluoride concentrations range from 0.1 to 9.1 mg/l and sulfate concentrations range from 0 to 2,119 mg/l. Adjusted SAR values for water samples obtained from the sandstone units of the Tongue River Member of the Fort Union formation ranged from 0 to 53. Water samples from the coal beds of the Fort Union had adjusted SAR values ranging from 2.6 to 101. Springs contained very hard water with calcium carbonate concentrations between 190 to 950 mg/l. Sulfate and fluoride concentrations ranged from 8.0 to 337 mg/l and 0.27 to 12.0 mg/l, respectively. The adjusted SAR ranged from 0.5 to 50.8.

Groundwater from sandstone and coal aquifers of the Tongue River Member is generally suitable to serve as a drinking water source; however, several samples from wells obtaining water from the coals did exceed the Primary Drinking Water Standards for chromium and fluoride. Water from the Tongue River aquifers is generally quite mineralized and not aesthetically pleasing. This water is generally undesirable for irrigation due to salinity problems; however, it is acceptable for livestock use.

Valley Fill—Alluvium

Water-quality for the valley fill-alluvium on the reservation appears to be a mixed-type, with the dominant ions being calcium, magnesium, sodium, bicarbonate and sulfate. A range of water-quality values in the alluvial systems is presented in Table 3-23.

Groundwater from the alluvium is generally suitable for drinking water with respect to the Primary Drinking Water Standards, although several samples taken from wells completed in the alluvium of Rosebud, Muddy, Lame Deer creeks and the Tongue River, equaled or exceeded the Primary Standards for cadmium. One sample from a well completed in the Rosebud Creek alluvium exceeded the limits for chromium and lead. The alluvial groundwater is quite mineralized with concentrations of TDS, sulfate, iron and manganese that often exceed Secondary Drinking Water Standards. Exceeding secondary standards does not represent a health hazard, but rather makes the water less desirable as a drinking water source for aesthetic reasons. The alluvial groundwater would probably be suitable for

TABLE 3-23

WATER-QUALITY OF THE ALLUVIUM ON THE NORTHERN CHEYENNE RESERVATION

Constituent	Rosebud Creek	Muddy Creek	Lame Deer Creek	Tongue River
TDS (mg/l)	374 - 2,048	1,082 - 1574	558 – 1,144	527 - 3,277
$CaCO_3$ (mg/l)	140 - 1,225	664 - 955	450 - 626	35 - 946
Sulfate (mg/l)	67 - 1,370	313 - 731	119 - 361	0 - 1,893
Nitrate (mg/l)	0 - 4.0	0 - 1.0	1.0 - 4.3	0.1 - 6.2
Fluoride (mg/l)	0 - 1.3	0.5 - 1.5	0.8 - 2.0	0.3 - 6.4
Adjusted SAR	0 - 34	5.2 - 6.0	5.2 - 6.0	4.3 - 51
No. wells tested	17	5 samples	4	12

Source: Northern Cheyenne Tribe 2002.

irrigation provided tolerant crops were used and special irrigation practices were instituted to prevent salinity and permeability problems. The water is acceptable for livestock use (Northern Cheyenne Tribe 2002).

Water Rights

The water rights of the Northern Cheyenne Tribe are set forth in the Northern Cheyenne-Montana Compact, which represents a statement of the federally reserved water rights held by the tribe. The Reserved Water Rights Compact Commission (RWRCC) of Montana describes Federal Reserved Water Rights as follows:

Federal Reserved Water Right

A federal reserved water right is a right to water that was created when Congress or the President of the U.S. reserved land out of public domain. The U.S. Supreme Court has ruled that enough water be reserved to meet the purposes for which the reserved lands were designated. The date that the land was withdrawn and the reservation created is the priority date of a federal reserved water right. Reserved water rights for Indian reservations, for instance, go back to the 1800s. Federal reserved water rights do not have the same restrictions placed on them as on state appropriative water rights. For example, a notice of appropriation or beneficial use is not required to maintain a federal reserved right and it is not lost due to non-use. The Tribe's reserved water right addresses three sources of water, the Tongue River, the Bighorn River and Rosebud Creek. The Compact entitles the Tribe to a priority date of October 1, 1884. This right provides for:

1. The diversion of 1,800 acre-feet per year, or the amount necessary to irrigate 600 acres, from Rosebud Creek.
2. The diversion of 30,000 acre-feet per year from the Bighorn Lake at Yellowtail Dam for any beneficial use.
3. The diversion of 32,500 acre-feet from the Tongue River for any beneficial use.
4. An additional 19,530 acre-feet from Rosebud Creek, for any beneficial use subject to the constraint that diversion and use do not adversely affect other water right holders of priority June 30, 1973 and earlier.

The extraction of alluvial groundwater by means of wells of less than 100 gallons per minute pumping capacity, exclusive of other water rights (Northern Cheyenne Tribe 2002).

History of Compact

In 1913, the state court of Montana initiated a proceeding to adjudicate water rights on Tongue River. In this proceeding, the federal government did not fully satisfy the Northern Cheyenne Tribe's *Winters v. U.S.* (207 US564) water rights claims to water in the Tongue River. Instead, the U.S. asserted a claim on behalf of the tribe only for the amount of water used by the Tribe at that time. In the Miles City Decree of 1914 (the Decree), the tribe was awarded only 30 cfs of water out of an available 425 cfs. The Decree established a priority date of 1909 for the Northern Cheyenne water claim: the next to last priority awarded in the Decree. The tribe's water right as set forth in the Decree was insufficient to irrigate the tribe's agricultural lands at the time and the late priority date established a high probability that the tribe would be out of water before the irrigation season began (Northern Cheyenne Tribe 2002).

The tribe has asserted that the failure to pursue the tribe's *Winters v. U.S.* (207 US564) rights claims constituted a breach of the federal trust responsibility. In 1975, the tribe filed an action in U.S. District Court to determine its water rights. The United States also filed suit on behalf of the tribe. In 1979, the state of Montana initiated proceedings for a general stream adjudication, which included the claims of the tribe. In that same year, the estate established the Montana Reserved Water Rights Compact Commission to negotiate a water rights settlement with the tribes of Montana. Negotiations with the Tribe began in 1980. Several years of negotiations yielded the Northern Cheyenne-Montana Water Rights Compact (the Compact). The Tribe formally approved the Compact on May 20, 1991, with Tribal Resolution #144. The Compact was ratified by the Montana State Legislature on June 11, 1991 and was re-ratified on December 16, 1993, by the 53rd Legislature Special Session (Northern Cheyenne Tribe 2002).

On September 30, 1992, the federal government ratified the Compact via "The Northern Cheyenne Indian Reserved Water Rights Settlement Act of 1992" (Pub. L. 102-374, 106 Stat. 1186) (Settlement Act). The purposes of the Settlement Act of 1992 are:

To achieve a fair, equitable and final settlement of all claims to Federal reserved water rights in the state of Montana of the Northern Cheyenne Tribe and its members and allottees and the U.S. on behalf of the Northern Cheyenne Tribe and its members and allottees. To approve, ratify and confirm the Water Rights Compact entered into by the Northern Cheyenne Tribe and the state of Montana on June 11, 1991. To direct the Secretary of the Interior to enter into a cooperative agreement with the state of Montana for the planning, environmental compliance, design and construction of the Tongue River Dam Project (P.L. 102-374, 106 Stat, 1186, Section 3(8)) in order to: implement the Compact's settlement of the Tribe's reserved water rights claims in the Tongue River Basin, protect existing Tribal contract water rights in the Tongue River Basin: provide [up to as per the Compact] 20,000 acre-feet per year of additional storage water for allocation to the tribe and allow the state to implement its responsibilities to correct identified Tongue River Dam safety inadequacies. To provide for the conservation and development of fish and wildlife resources in the Tongue River Basin. To provide for the enhancement of fish and wildlife habitat in the Tongue River Basin. To authorize certain modifications to the purposes and operation of the Bighorn Reservoir in order to implement the Compact's settlement of the Tribe's reserved water rights claims. To authorize the Secretary of the Interior to take such other actions as are necessary to implement the Compact.

Northern Cheyenne Tribal Water Policy and Management

Northern Cheyenne Water Code: The Northern Cheyenne Water Code sets the regulatory framework for the management of tribal water resources on the reservation. The purpose of the Water Code is to preserve and protect the quantity and quality of Tribal water resources through wise use, administration, management and enforcement. This includes, but is not limited to, permitting and prioritizing tribal water use, long-term planning to ensure the sustainability of resources, encouraging conservation practices and protecting traditional, religious and cultural uses of water (Northern Cheyenne Tribe 2002).

- Tribal Water Resources Board and Administrator: The administration of the Water Code will be the responsibility of a Tribal Water Administrator (TWA) and a Tribal Water Resources Board (Water Board). The Tribal Water Board is responsible for adopting new rules and regulations, approving or disapproving permits, reporting to the Tribal Council on relevant water-related issues, declaring critical management areas and water supply conditions, establishing and maintaining a technical staff to administer and enforce the Code and developing recommendations for long-term funding sources to support tribal water management.

- The TWA: The TWA issues citations and initiates enforcement proceedings for violations of the Code. The TWA administers water rights, monitors and enforces water use through inspections, responds to emergency situations, collects data and researches development possibilities and conducts educational programs. Recommendations are made to the Water Board on critical management areas and methods for improving water use and efficiency. The TWA develops and submits an annual budget and report to the Water Board.

- Water Management: The Water Code sets forth the primary physical, hydrologic and engineering principles guiding the management of surface and groundwater resources on the reservation. These procedures are required to effectively manage, fully utilize and protect the water rights of the Northern Cheyenne Tribe and to assure compliance with applicable laws and requirements of the Northern Cheyenne Montana Compact of 1991 and the Northern Cheyenne Water Rights Settlement Act of 1992. The Water Board will adopt a Comprehensive Water Management Plan at least every 5 years to guide water resource decisions, permitting and management. Surface water and groundwater is evaluated and no later than March 1 of each year, the condition of these resources is declared. Water

allocation procedures for both surface and groundwater are outlined in this section for use during drought conditions.

- Permitting: A water permit is required to divert or undertake any activity affecting or involving tribal water. This includes water diversions, discharge, injection, transfers, surface water alterations, groundwater recharge, storage impoundments, or hydropower generation. The Code clearly identifies the application process outlining the procedures, hearings and resolution of water disputes. The Water Board will preside over all hearings. The Tribal Court will enforce subpoenas issued by the Water Board.

- Enforcement: Prohibited acts and penalties are clearly outlined in the Water Code. Any person who commits prohibited acts shall be subject to civil proceedings before the Water Board on citation by the Tribal Water Administrator. All decisions of the Water Board shall be appealable directly and exclusively to the Tribal Courts.

- Summary: The Northern Cheyenne Water Code contains the provisions and guidelines to effectively manage the water resources of the reservation, however, with the fairly recent approval of the Water Code, the Tribal Water Resources Board has not yet been established. Currently, no permitting process or accounting for water resources exists on the reservation. Once underway, the Water Code will empower the Tribe by enabling them to control and protect the water resources on the reservation.

- Northern Cheyenne Tribe Draft Surface Water Quality Standards: A water quality standard defines the water quality goals for a water body, or portion thereof, by designating the use or uses to be made of the water, by setting criteria necessary to protect the uses and by protecting water quality through antidegradation provisions. The Tribe has adopted these standards to protect public health and welfare, enhance the quality of water and serve the purposes of the Federal Clean Water Act. Currently, the Northern Cheyenne Tribe's Draft Surface Water Quality Standards have been submitted to the EPA and the public review process is near completion. In addition, the Tribe's application under Section 518 of the Clean Water Act for Treatment as a State for the purposes of implementing the Clean Water Act's water quality standards program is still pending before the EPA. The Tribe's Treatment as a State application and water quality standards are vital in the Tribe's water quality protection program and aid in evaluating potential impacts on water quality from a broad range of causes and sources.

- A primary purpose of the water quality standards is to guide efforts to monitor and assess surface water quality within the reservation. Any regulatory pollution controls established by the Tribe or the Federal Government must be developed to ensure a level of water quality that will satisfy these water quality standards. Surface water quality standards are adopted to establish maximum allowable levels or concentrations of pollutants and provide a basis for protecting water quality that is presently better than standards required for surface water quality. They serve to establish a basis for limiting the introduction of pollutants, which could affect existing or designated uses of reservation surface waters. The following surface water characteristics and policies are described in the Draft Water Quality Standards:

- Beneficial Uses: Beneficial use classifications are designated to all surface waters of the reservation in order to achieve national "fishable and swimmable" goals. Narrative water quality criteria and sampling methods are described along with the tribe's biological and radiological surface water standards.

- Antidegradation Policy: The tribe's antidegradation policy is consistent with the federal antidegradation policy found in EPA's water quality standards regulation. The purpose of the policy is to protect existing water quality where the quality of the water is better than required to support the designated uses.

- Mixing Zone and Dilution Policy: The mixing zone and dilution policy describes how dilution and mixing of point source discharges within receiving waters will be addressed in developing discharge limitations for point source discharges. Compliance requirements and 401 Certification procedures are also described. The requirements for standards implementation are outlined. Once approved and adopted by EPA, the Tribe's standards program will have the same legal standing as those adopted by states. The federal government will be responsible for the enforcement of the standards. EPA Region VIII will have the responsibility of enforcing requirements applicable to point source discharges, including those permit requirements that are based on the Tribe's water quality standards.

TABLE 3-24

NORTHERN CHEYENNE NUMERIC STANDARDS FOR EC AND SAR AND TDS INDICATOR VALUES

	Electrical Conductivity (EC) µS/cm[1]	Sodium Adsorption Ratio (SAR)[2]	Total[3] Dissolved Solids (TDS) mg/l
Southern Boundary			
Irrigation period 30-day average[4]	1,000	--	660
Year-round instantaneous maximum	2,000	2.0	1,320
Northern Boundary			
Irrigation period 30-day average	1,500	--	990
Year-round instantaneous maximum	2,000	3.0	1,320
Tributaries			
Irrigation period 30-day average	1,500	--	990
Year-round instantaneous maximum	2,000	3.0	1,320

Source: Northern Cheyenne Tribe 2002.

[1]The EC values are numerical water quality standards. EC is an expression of salinity as electrical conductance reported in microSiemens per meter at 25 degrees C (µS/cm). Notc that 1,000 µS/cm = 1 deciSiemen per meter (dS/m).

[2]The SAR values are numerical water quality standards. SAR is an expression of the concentration of sodium relative to the square root of the average of the concentrations of calcium and magnesium in water where all constituents are in milliequivalants per liter (meq/l).

[3]The TDS values are indicator values and are not water quality standards. TDS is an expression of salinity as total dissolved solids in mg/L. The TDS values will be used to monitor conditions and trends in Tribal waters. If a TDS indicator value is exceeded, the tribe will evaluate the cause and, where appropriate, make necessary adjustments to the EC water quality standard(s). Any change to the EC standard will be made through the tribe's water quality standards-setting process.

[4]The irrigation period is defined by the tribe as April 1 through November 15 annually.

- SAR and EC. The Tribe is especially concerned about salinity and its impacts on riparian areas and irrigated lands. The Tribe has developed numeric criteria for the Sodium Adsorption Ratio (SAR) and Electrical Conductivity (EC) of waters of the reservation to address these concerns. The proposed numeric standards for EC and SAR are presented in Table 3-24. The rationale behind the numeric criteria for SAR is based on James Bauder's final report, "Recommended In-Stream Standards, Thresholds and Criteria for Irrigation or Water Spreading to Soils of Alluvial Channels, Ephemeral Streams, Floodplains and Potentially Irrigable Parcels of Land within the Boundaries of the Northern Cheyenne Reservation" (Bauder 2001).

In response and consideration of comments, concerns and objections received from various parties, modifications have been incorporated into the proposed surface water standards for EC and SAR of the Northern Cheyenne Reservation.

Table 3-24 shows revised numeric standards for EC and SAR and indicator values for TDS applicable to the mainstems of the Tongue River and Rosebud Creek and their tributaries.

Land Use and Realty

The Northern Cheyenne Reservation comprises approximately 2 percent of the land in the Planning Area. The Northern Cheyenne lands are used for cattle production, mining, logging and lumber production, residential and recreation (Madison 2001). About 27,000 acres of reservation lands are presently under cultivation; the vast majority of this is dry-land farming, an additional 105,000 acres is composed of forested land that is considered commercially harvestable (U.S. Dept. of Commerce 1996).

The principal communities located on the Northern Cheyenne Reservation are as follows:

- Lame Deer—Lame Deer is located in Rosebud County approximately 21 miles west of Ashland between Busby and Custer National Forest along Highway 212/39. Lame Deer is the tribal headquarters and home of the Northern Cheyenne Powwow. There are approximately 1,925 Indian people residing in Lame Deer.

- Ashland—Ashland is located in Rosebud County 70 miles south of Miles City between Birney and Brandenburg along Highway 212 on the banks of the Tongue River near the Custer National Forest. Approximately 500 Indian people live in Ashland.

Recreation

The Northern Cheyenne Reservation also provides dispersed outdoor recreation activities for tribal members. Activities include hunting, fishing, hiking, horseback riding and plant and berry gathering. Unrestricted hunting is limited to tribal members.

Developed recreation sites include Crazy Head Springs and Lost Leg Lake (fishing, camping, picnicking); Green Leaf, Red Nose, Parker and LaFerre ponds (fishing); and Morning Star Lookout. Undeveloped sites include Buffalo Jump and Badger Peak.

Camping facilities exist at the Northern Cheyenne Craft Center in Lame Deer and at the Morning Star View Campgrounds. Tribal buffalo herds are pastured near Lame Deer Ice Well Campgrounds. A museum/curio shop is under development; this will serve, in part, as an outlet for the work of numerous tribal artists and craftspeople. The tribe holds a 4th of July powwow each year, which is widely attended. Finally, many visitors on their way to Glacier and Yellowstone parks, the Little Bighorn Battlefield and other regional attractions find it convenient to stop by the reservation.

The only developed recreation area on the Northern Cheyenne Reservation is Crazy Head Springs. Picnic and camping facilities are available at the spring, which is used heavily. There are also several parks on the reservation including Birney Park, White Moon Park, Tongue River Park, Busby Park and Lame Deer Park.

The Northern Cheyenne Reservation has lost recreational facilities in recent years with the closure of a swimming pool at Lame Deer Park and the loss of other park facilities with the opening of a new health center. A public gym was also removed to make room for a tribal government center.

Soils

Soils in the reservation, just like soils in the surrounding RMP area, are derived mainly from sedimentary bedrock and alluvium. The soils generally range from loams to clays, but are principally loams to silty clay loams. For more information on soil types, see the Soils Appendix.

Vegetation

The same types of vegetative communities as described in this chapter are anticipated to be found on the reservation. It is understood that the Northern Cheyenne Tribe considers certain plants to be sacred for their medicinal or traditional values.

The major native plant communities on Northern Cheyenne Lands include grass and shrub rangelands, forestlands and riparian areas. These classifications are similar to those for the project area as a whole. These classifications are discussed in detail in the Vegetation section. Approximately 391,852 acres are classified as rangelands and 147,319 are classified as forestlands (Northern Cheyenne Tribe 2002). There are approximately 20,000 acres of riparian wetlands on Northern Cheyenne lands. Dominant species for these community types can be found under the Crow Reservation Vegetation section.

Special Status Species

The Northern Cheyenne have many sacred plants that are used for ceremonial and traditional uses. There are at least 170 plants with documented traditional or cultural uses (Northern Cheyenne Tribe 2002).

Wildlife

Wildlife habitat types and species occurring on the Northern Cheyenne Reservation are also generally the same as those described for the CBNG study area. Population estimates are not available because of a lack of population survey data. However, the limited available data suggest that big game populations are far below what the habitat can support (Northern Cheyenne Tribe 2002). Mule and white-tailed deer populations have declined recently because of year-round hunting. Mackie (2004) surveyed mule deer on the southern portion of the Northern Cheyenne Reservation and adjacent public and private lands from April 27 to April 29, 2004. The surveys covered approximately 250 square miles. Two hundred forty-seven mule deer were observed, 35 (14 percent) of which were recorded on the Northern Cheyenne Reservation. A second spring mule deer survey was conducted over two days in April 2005 on the southern portion of the Northern Cheyenne Reservation and adjacent public lands. Two hundred twenty-one mule deer were observed, while 20 white-tailed deer and 46 pronghorn were also observed. Most big game animals (mule deer and pronghorn) were observed on private and public lands south of the reservation boundary. As in other dry Western areas, riparian areas are the single most important wildlife habitat for many species. The riparian communities and mixed terrain of the Tongue River breaks have been identified as especially valuable wildlife habitat.

Sage-grouse are widely distributed in suitable habitat. However, their numbers have declined on the reservation over the last 20 years. Black-tailed prairie dogs, black-footed ferrets, swift fox, mountain plovers, bald eagles and peregrine falcon are species of concern found on the Northern Cheyenne Reservation (Northern Cheyenne Tribe 2002). Captive-bred black-footed ferrets were released in January of 2008 within the boundary of the Northern Cheyenne Indian

Reservation. With the exception of swift fox, these species of concern are considered under the Wildlife: Special Status Species section for the total project area. Swift fox (*Vulpes velox*) are one of the smallest foxes in the world and are only found in the Great Plains of North America. They were removed as a Candidate Species for Threatened Status by the USFWS on January 8, 2001. Their numbers are believed to be stable, but there is still concern for their future. They prefer short to mid-grass prairies, but they also sometimes inhabit mixed agricultural land (Egoscue 1979; Uresk and Sharps 1986).

The Northern Cheyenne Reservation is within that portion of the CBNG Planning Area associated with the Powder River RMP area. The Northern Cheyenne Tribe (2002) stated that the major streams of concern on the Northern Cheyenne Reservation are the Tongue River and Rosebud Creek. The Tribe reported that Rosebud Creek could support a game fish population if there were an assured flow and temperature control. The Tribe noted that Rosebud Creek is not suited for trout, but that it could support smallmouth bass—a species that prefers cool-water streams with clean bottoms and extensive riffles. Table WIL-2 (Wildlife Appendix) summarizes aquatic resources characteristics and resource values from the Montana NRIS (2001) Internet data base for the upper Tongue River and Rosebud Creek.

The Northern Cheyenne Tribe (2002) reported there is a diversity of aquatic resources on the Northern Cheyenne Reservation, including some 32 different fish species. The Tribe, citing fisheries studies conducted in the vicinity of the reservation in 1973 (HKM 1973), stated that a reproducing population of smallmouth bass had been established in the Tongue River. Other important species of sport fish that were collected in the Tongue River include walleye, sauger, northern pike and channel catfish. The Tribe also noted that the Tongue River is unique in supporting the only population of rock bass in Montana. Table WIL-3 in the Wildlife Appendix summarizes fish species composition and abundance information from the Montana NRIS (2001) Internet data base for the upper Tongue River and Rosebud Creek.

Lower Brule Sioux Tribe

The Lower Brule Sioux Tribe of South Dakota has expressed a concern to BLM regarding TCPs found within the SEIS Planning Area. The tribe's concerns center around the possible destruction or loss of its TCPs due to CBNG exploration and development. The MCFO has signed a Memorandum of Understanding (MOU) with the tribe to participate in the SEIS as a cooperating agency. The MCFO has also entered into government-to- government consultation with the tribe to address these concerns. At this time, the number and location of the TCPs in question are unknown. It is anticipated that this information will be transferred to BLM as the consultation process matures.

Paleontological Resources

Paleontological resources consist of fossil-bearing rock formations containing information that can be interpreted to provide a further understanding about Montana's past. Fossil-bearing rock units underlie the entire Planning Area. While fossils are relatively rare in most rock layers, there are seven geologic rock units within the Planning Area that do contain significant fossil material. Rock units that are known to contain fossils are the Tullock and Ludlow Members of the Fort Union Formation, the Judith River, Hell Creek, Morrison and Cloverly Formations, the Lakota Sandstone Formation and the White River Group. Figure 3-1 is a stratigraphic section showing the age and relative position of each of these fossil-bearing units.

The Morrison, Hell Creek, Cloverly and Lakota Sandstone formations are noted for the occurrence of dinosaur fossils. The Bridger Fossil ACEC, a 575-acre site located in Carbon County within the Billings RMP area, contains outcrops of both the Cretaceous Period Cloverly Formation and the Jurassic Period Morrison Formation. Outcrops of the Morrison Formation within the Bridger Fossil area have yielded the fossil remains of numerous juvenile and subadult sauropods. The Bridger Fossil Area is one of two listed National Natural Landmarks within the Billings RMP area, the other is the Cloverly Formation site in Bighorn County (Federal Register 48(41):8693 1983). There are other areas within the SEIS study areas that have been nominated for National Natural Landmarks for paleontological resources.

The Judith River Formation preserves the fossil record from ancient environments including shallow oceans, deltas, rivers, freshwater swamps and lakes. The Judith River Formation contains the fossil remains of plants as well as many animal species including mollusks, fish, amphibians, lizards, small mammals, dinosaurs and other reptiles.

The Cretaceous Period Hell Creek Formation preserves the fossil record of a subtropical to tropical environment that was characterized by low plains interrupted by broad swampy bottoms and deltaic areas. Fossil remains from the Hell Creek Formation include a wide variety of plants, mollusks, fish, amphibians, reptiles, birds, small mammals and dinosaurs. Fossil dinosaur remains include *Triceratops, Anatosaurus and Tyrannosaurus.* The fossil record of plant and animal communities found within the Hell Creek Formation varies between low moist areas and the drier, upland plains environments that were present in the past. The Castle Butte ACEC, located in Yellowstone County within the Billings RMP area, contains outcrops of the Hell Creek Formation, which are noted for their paleontological resources.

The contact between the Cretaceous Period Hell Creek Formation and the Paleocene Tullock/Ludlow Member of the Fort Union Formation marks an important event in time. This contact represents a time of worldwide extinction for many animals, most notably the dinosaurs and the beginning of the rapid evolution of mammals. The fossil record from the Fort Union Formation contains evidence of ancient environments that include streamside swamps, bottomlands and well-established river courses. Fill within ancient river channels contains fossils of fresh water clams and snails. The Tullock/Ludlow Member is the primary fossil-bearing unit of the Fort Union Formation and contains fossils of turtles, fish, reptiles and mammals.

The Tertiary Period White River Group is considered an important source of fossil mammals. Although the White River Group outcrops in the Planning Areas, the majority of the fossil-bearing areas are in the Dakotas.

Recreation

Montana's natural features, coupled with the large amount of state and federal lands, offer residents and vacationers a variety of year-round recreational opportunities. Montana has thousands of miles of streams, hundreds of lakes, reservoirs, mountainous areas, rolling hills and grassland prairies—many of which are available for recreational purposes.

The Planning Area, which includes the Billings and Powder River RMP areas, is replete with recreational opportunities that vary with seasonal changes. Spring and summer provide opportunities for fishing, hiking, photography, wildlife viewing, spring turkey hunting, water sports (powered and non-powered), off-road vehicle activities, camping, picnicking, touring (vehicle and bicycle) and caving. Early to late fall is hunting season. Winter brings the winter sports of skiing, snowshoeing and snowmobiling. The Planning Area provides vast areas for people to enjoy. Some of the benefits and experiences enjoyed by recreational users include opportunities for solitude, spending time with families, enhancing leisure time and improving sports skills.

Federal

There are three national forests in the Planning Area: Custer, Gallatin and Lewis and Clark. These forests provide a variety of yearlong, outdoor recreation. The Absaroka Beartooth Wilderness in the Gallatin National Forest provides unique wilderness opportunities for hiking, horseback riding, camping, fishing, hunting, wildlife viewing and photography. The Lewis and Clark Historic Trail and the Nez Perce National Historic Trail provide opportunities for hiking, photography, wildlife viewing and historic touring.

The Bighorn Canyon National Recreation Area is a popular area for camping, fishing, boating, hiking, wildlife viewing and photography. West of and adjacent to the Bighorn Canyon National Recreation Area is the Pryor Mountain Wild Horse Range where off-road vehicles are not allowed and skiing, caving, hiking and wildlife viewing occur.

The BLM has land holdings throughout the state. The majority of this land is not contiguous; it is fragmented and many times isolated by private holdings. Most of this land is managed for multiple uses. Recreational opportunities include hiking, horseback riding, off-road vehicle travel, fishing, hunting, wildlife viewing, camping, picnicking, caving, skiing and snowshoeing. Included in this land are the Pryor Mountain Wild Horse Range and the Pompey's Pillar National Monument.

There are seven National Wildlife Refuges in the Planning Area— one in Golden Valley County, four in Musselshell County and two in Stillwater County. They provide opportunities for wildlife viewing, hiking and photography.

According to 33 CFR Part 329, navigable waters of the U.S. are those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible for use to transport interstate or foreign commerce. A determination of navigability, once made, applies laterally over the entire surface of the water body and is not extinguished by later actions or events that impede or destroy navigable capacity. A determination whether a water body in the project area is a navigable water of the U.S. is made by the U.S. Army Corps of Engineers Omaha District's Division Engineer and is based on a report of findings prepared at the district level in accordance with the criteria set out in regulations. Tabulated lists of final determinations of navigability are maintained in the District office and are updated as necessitated by court decisions, jurisdictional inquiries, or other changed conditions.

State

There are nine state parks within the SEIS Planning Area that offer outdoor activities, Native American history and geological sites, wildlife preserves, water sports, photography, hiking, camping and fishing. These parks are Chief Plenty Coups, Cooney Reservoir, Greycliff Prairie Dog Town, Lake Elmo, Medicine Rocks, Natural Bridge, Pictograph Cave, Rosebud Battlefield and Tongue River Reservoir.

In addition, state-owned lands checkerboard the Planning Area. Much of this land is surrounded by private or federal land. Recreational opportunities include hunting, fishing, wildlife viewing, hiking, snowmobiling and skiing. Navigable waterways and islands owned by the state also provide additional recreational opportunities.

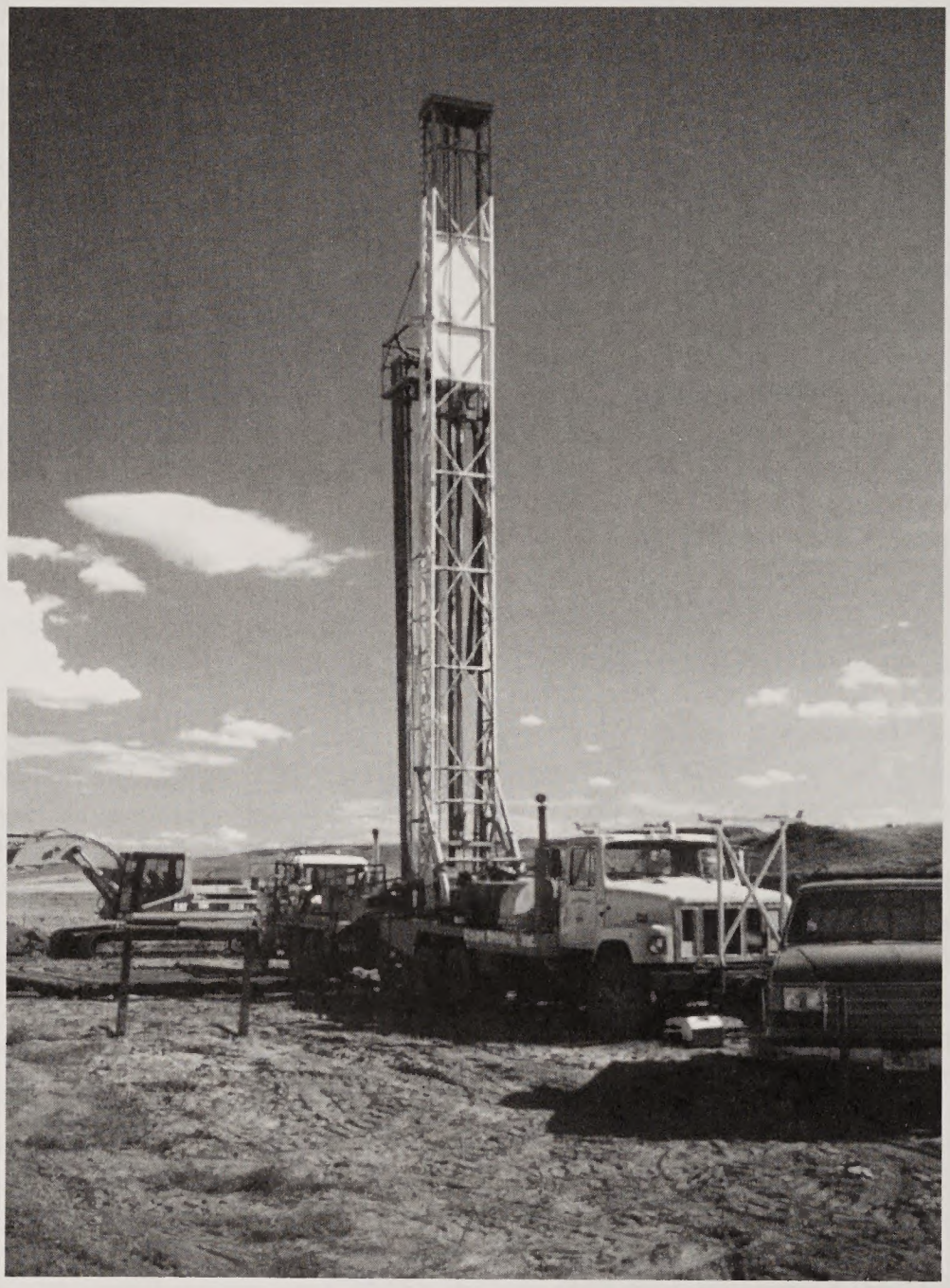
Local/City Recreation

Within the Planning Area, the larger municipalities of Billings, Laurel and Miles City, offer museums, parks, baseball fields, rodeo grounds/fairgrounds, walking/hiking/bike trails, water sports and other opportunities. The other municipalities in the Planning Area offer a city park, outdoor sports activities at the schools and, depending on the municipality, possibly a museum or rodeo grounds.

Private Lands

In addition to public lands, recreational opportunities also exist on privately owned lands, including private

campgrounds, resorts and dude ranches. Activities such as hunting and backcountry trips also may be permitted on privately owned land with landowner consent. Recreational opportunities also arise on private lands as a result of Montana Fish, Wildlife and Parks (MFWP) actions, such as hunting opportunities through the block management program and conservation easements.



Typical mobile rig used to drill shallow CBNG wells

Social and Economic Values

This section examines social, economic and environmental justice information for the 13 counties in the SEIS Planning Area. The three counties with the most potential CBNG wells are Big Horn, Powder River and Rosebud counties. These counties are located adjacent to each other in southeastern Montana (see Map 1-1). The Crow and Northern Cheyenne Reservations are located predominantly in Big Horn and Rosebud counties. Information on these reservations is located in this section as well as the sections entitled *Indian Trust Assets and Native Americans* in this chapter. CBNG production in Montana may also affect Sheridan and Campbell Counties in Wyoming, the counties from which the CBNG workforce would likely commute. See the Wyoming Oil and Gas EIS for information on the affected environment for Sheridan and Campbell Counties (BLM 2005e).

Demographics

Population data for Montana and the 13-county Planning Area is presented in Table 3-25. Between 1990 and 2000, the population in Montana increased at an average annual rate of 1.2 percent to 902,195 persons. The 13-county Planning Area grew at a slightly slower rate of 1.1 percent over the same period. Two counties—Stillwater and Carbon—grew faster than the average for the Planning Area, with average annual rates of 2.5 percent and 1.8 percent, respectively. Four counties—Carter, Powder River, Rosebud and Treasure—had negative growth rates and lost population.

The forecasted population for the year 2020 is also shown in Table 3-25. For both the state and the Planning Area, the forecasts show compatible growth over the next 20 years compared to the last 10 years. State population is forecast to grow by 1.0 percent and the Planning Area is forecast to grow by 1.1 percent. Two counties—Rosebud and Stillwater— are projected to grow at equal or greater rates than the average for the Planning Area, with rates of 2.3 percent and 1.5 percent, respectively. Population in Treasure County is forecast to fall, with a rate of -0.4 percent. However, personal communication with the Montana Department of Labor and Industry indicates that the projected population of 13,720 for Rosebud County in the year 2020 is an overestimate and that a more likely future population is 12,200 or 12,500 (Montana Department of Labor and Industry 2001b). These numbers correspond to annual growth rates of 1.5 percent and 1.7 percent, respectively, which are more consistent with the average for the Planning Area and the state.

TABLE 3-25
HISTORICAL POPULATION AND POPULATION FORECASTS

	1990 (Census)	2000 (Census)	Percent Annual Average Growth 1990-2000	2020 (Forecast)	Percent Average Annual Growth 2000-2020[1]
Big Horn County	11,337	12,671	1.2%	14,880	0.9%
Carbon County	8,080	9,552	1.8%	11,390	1.0%
Carter County	1,503	1,360	-1.0%	1,470	0.4%
Custer County	11,697	11,696	0.0%	13,060	0.6%
Golden Valley County	912	1,042	1.4%	1,180	0.7%
Musselshell County	4,106	4,497	1.0%	5,390	1.0%
Powder River County	2,090	1,858	-1.1%	1,770	-0.2%
Rosebud County	10,505	9,383	-1.1%	13,720	2.3%
Stillwater County	6,536	8,195	2.5%	10,590	1.5%
Sweetgrass County	3,154	3,609	1.4%	3,870	0.4%
Treasure County	874	861	-0.1%	800	-0.4%
Wheatland County	2,246	2,259	0.1%	2,330	0.2%
Yellowstone County	113,419	129,352	1.4%	158,310	1.1%
Planning Area	176,459	196,335	1.1%	238,760	1.1%
State of Montana	799,065	902,195	1.3%	1,082,260	1.0%

Source: Montana Department of Commerce, 2001. Census and Economic Information Center. Projections by NPA Data Services, Inc.

[1] 1990 to 2000 percent average annual growth rates corrected for rounding from original calculations and 2000 to 2020 percent average annual growth calculations corrected to use a 20-year range.

Data on race and ethnicity from the 2000 U.S. Census are shown in Table 3-26. The data indicate that the Montana population is 90.6 percent white, similar to the 13-county Planning Area, which is 88.8 percent white. Statewide and in the Planning Area, Native Americans make up the largest non-white group, totaling 6.2 percent and 7.7 percent, respectively. Persons identified as Hispanic or Latino (of any race) compose 2.0 percent of the state population and 3.1 percent of the 13-county area population.

While 11 of the 13 counties are between 92.8 percent and 99.1 percent white, two of the counties—Big Horn and Rosebud—include Indian reservations with substantial Native American populations. Big Horn County, which includes most of the Crow Reservation and part of the Northern Cheyenne Reservation, has a Native American population of 59.7 percent. Rosebud County also includes part of the Northern Cheyenne Reservation and is 32.4 percent Native American.

TABLE 3-26

RACE/ETHNICITY AS PERCENT OF TOTAL POPULATION

Geographic Area	Total Population	Percent White	Percent Black or African American	Percent American Indian and Alaska Native	Percent Asian	Percent Native Hawaiian and Other Pacific Islander	Percent Some Other Race	Two or More Races	Percent Hispanic or Latino (of any race)[1]
Big Horn County	12,671	36.6%	0.0%	59.7%	0.2%	0.0%	0.7%	2.8%	3.7%
Carbon County	9,552	97.1%	0.3%	0.7%	0.4%	0.0%	0.6%	1.0%	1.8%
Carter County	1,360	98.6%	0.1%	0.4%	0.1%	0.0%	0.3%	0.5%	0.6%
Custer County	11,696	97.0%	0.1%	1.3%	0.3%	0.1%	0.3%	1.0%	1.5%
Golden Valley County	1,042	99.1%	0.0%	0.6%	0.1%	0.0%	0.0%	0.2%	1.2%
Musselshell County	4,497	96.9%	0.1%	1.3%	0.2%	0.0%	0.4%	1.2%	1.6%
Powder River County	1,858	97.4%	0.0%	1.8%	0.1%	0.0%	0.2%	0.5%	0.6%
Rosebud County	9,383	64.4%	0.2%	32.4%	0.3%	0.0%	0.7%	2.0%	2.3%
Stillwater County	8,195	96.8%	0.1%	0.7%	0.2%	0.0%	0.9%	1.2%	2.0%
Sweet Grass County	3,609	97.0%	0.1%	0.6%	0.3%	0.0%	0.7%	1.3%	1.5%
Treasure County	861	96.4%	0.1%	1.6%	0.3%	0.0%	0.9%	0.6%	1.5%
Wheatland County	2,259	97.0%	0.1%	0.6%	0.2%	0.2%	0.3%	1.6%	1.1%
Yellowstone County	129,352	92.8%	0.4%	3.1%	0.5%	0.0%	1.3%	1.9%	3.7%
Planning Area Total	**196,335**	**88.8%**	**0.3%**	**7.7%**	**0.4%**	**0.0%**	**1.1%**	**1.8%**	**3.1%**
MONTANA	902,195	90.6%	0.3%	6.2%	0.5%	0.1%	0.6%	1.7%	2.0%

Source: U.S. Census Bureau, Census 2001a Redistricting Data (Public Law 94-171) Summary File, Matrices PL1 and PL2.
[1]Percent numbers in this column are a subset of one or more of the other race/ethnicity designation percentages.

Table 3-27 shows the percentage of people below the poverty level (as defined by the U.S. Census Bureau, 2001b) for Montana and each of the 13 Planning Area counties (1997 data). The Census Bureau uses a set of money income thresholds that vary by family size and composition to determine who is poor. Compared to the state as a whole, the 13-county Planning Area has a somewhat greater percentage of people below the poverty level; some counties within the Planning Area have poverty rates that are much higher than average for the state.

In 1997, the percentage of the population of Montana below the U.S. Census Bureau poverty threshold was 15.5 percent; the average in the 13-county Planning Area was 17.3 percent. Nine of the 13 counties in the Planning Area have poverty rates greater than the state average. The county with the highest rate is Big Horn where more than one quarter of the population had an income below the poverty level in 1997. The total number of persons in the Planning Area below the poverty level was about 27,934. This represents about 20.6 percent of the state's total population below the poverty level.

Table 3-17 in the Native Americans section of Chapter 3 shows the percent of tribal members who are employed but below U.S. Health and Human Services poverty guidelines (similar to U.S. Census guidelines). These data indicate that the percent of tribal members who are employed but below the poverty guideline is greater than the total percent of persons below poverty for the respective counties where the tribes are located. It can be inferred that the total poverty rate for all tribal members (employed and unemployed) would be even greater than just for those who are employed, suggesting relatively large numbers of persons on the reservations living in poverty.

The three counties with the most potential CBNG wells, Big Horn, Powder River and Rosebud counties, have a combined 2000 population of 24,000, which is less than 10 percent of the total population of the Planning Area. Two of these counties, Powder River and Rosebud, lost population during the previous decade (both lost 11 percent), while Big Horn County grew 12 percent during the same time period. Big Horn and Rosebud counties are forecasted to grow 17 percent and 30 percent, respectively, between the years of 2000 and 2020. Powder River County, with its population of 1,858, is projected to continue to slowly lose population between 2000 and 2020. The county seats are in Hardin in Big Horn County with a 2000 population of 3,384, Broadus in Powder River County with a 2000 population of 451 and Forsyth in Rosebud County with a 2000 population of 1,944. There are numerous small reservation communities located in Big Horn and Rosebud counties. In 1990, Big Horn County, which includes most of the Crow Reservation

TABLE 3-27

POVERTY STATUS BY COUNTY (AS DEFINED BY U.S. CENSUS BUREAU) (1997)

	Number of Persons Below Poverty Level	Percent of Population Below Poverty
Big Horn County	3,768	29.6%
Carbon County	1,230	12.9%
Carter County	294	19.3%
Custer County	2,022	17.0%
Golden Valley County	216	21.2%
Musselshell County	893	19.4%
Powder River County	277	15.3%
Rosebud County	1,999	19.9%
Stillwater County	860	10.6%
Sweetgrass County	418	12.3%
Treasure County	141	15.8%
Wheatland County	453	19.8%
Yellowstone County	15,363	12.1%
Planning Area Total	**27,934**	**17.3%**
Montana	**135,691**	**15.5%**

Source: U.S. Census Bureau Small Area Income and Poverty Estimates Program 2001b.

and part of the Northern Cheyenne Reservation, had a population that was nearly 60% Native American. Rosebud County, which includes most of the Northern Cheyenne Reservation, had a 2000 population that was 32 percent Native American. The 1997 poverty rates for Big Horn, Powder River and Rosebud counties were 29.6 percent, 15.3 percent and 19.9 percent, respectively. These rates reflect the relatively large numbers of persons on the reservations living in poverty. For additional information on demographics for the Northern Cheyenne and Crow Tribes see Social and Economic Values in the Native Americans section of this Chapter.

Social Organization

Housing Units and Vacancy

Housing units and vacancy rates for Montana and the 13-county Planning Area are shown in Table 3-28. The latest available county-specific data on housing units is from the 2000 Census (U.S. Census Bureau 2001b). Although the vacancy rates reported here illustrate the averages in the counties in the Planning Area, sub-county variations may exist as a result of factors such as high population growth in a portion of the county.

In 2000, Montana had 412,633 housing units, 84,952 or 21 percent of these were in the 13-county Planning Area. Eleven percent (9,574) of the Planning Area housing units was located in Big Horn, Rosebud and Powder River counties.

Homeowner vacancy rates indicate the percent of total owner-occupied housing that is vacant. In Montana, the homeowner vacancy rate for 2000 was 2.2 percent, compared to 3.6 percent for the Planning Area. Four counties had home ownership vacancy rates higher than the Planning Area average, suggesting a surplus of vacant houses on the market. The three counties with the most potential for CBNG wells, Big Horn, Powder River and Rosebud, all had lower homeowner vacancy rates than the Planning Area average. Housing availability on the Northern Cheyenne and Crow Reservations is discussed under Social Organization in the Native Americans section of this chapter.

The rental vacancy rate in 2000 was 7.6 percent for the state and 14.0 percent for the Planning Area. Generally, rental vacancy rates between 5 percent and 10 percent are considered adequate. Rental vacancy rates below 5 percent can indicate potential rental shortages and above 10 percent can indicate potential surplus. The rental vacancy rates for the three counties with the most potential for CBNG wells, Big Horn, Powder River and Rosebud, were 6.3 percent, 13.1 percent and 11.7 percent, respectively.

TABLE 3-28
HOUSING UNITS

	2000 Housing Units	2000 Homeowner Vacancy Rate (%)	2000 Rental Vacancy Rate (%)
Big Horn County	4,655	2.2	6.3
Carbon County	5,494	3.0	8.1
Carter County	811	6.9	8.1
Custer County	5,360	2.6	11.6
Golden Valley County	450	6.3	8.8
Musselshell County	2,317	6.8	8.4
Powder River County	1,007	3.0	13.1
Rosebud County	3,912	1.9	11.7
Stillwater County	3,947	2.7	6.1
Sweetgrass County	1,860	2.1	10.3
Treasure County	422	2.3	6.4
Wheatland County	1,154	6.4	18.2
Yellowstone County	54,563	1.2	5.4
Planning Area Total	**85,952**	**3.6%**	**14.0%**
Montana	**412,633**	**2.2%**	**7.6%**

Source: U.S. Census Bureau 2001.

Temporary Housing

Temporary housing units are typically defined to include hotels and motels and recreational vehicle or camping sites. An inventory of temporary housing units is typically included in an environmental impacts analysis to use in determining potential impacts on the local housing supply from an influx of temporary population (such as construction workers or other employees). This data is typically gathered for a city, county, or small region. Because of the broad scope of this study, however, an inventory of accommodations by specific location was not attempted. A large number of hotels/motels and recreational vehicle and camping areas are available throughout the state and the 13-county Planning Area. These sites tend to be concentrated in and around the large cities, such as Billings, as well as major tourist or recreation areas, such as Yellowstone National Park. They are less likely to be available in the three counties with the most potential for CBNG wells.

Public Services and Utilities

Public services, typically provided by local governments (cities, counties and special service districts), include police and fire protection, emergency medical services, schools, public housing, parks and recreation facilities, water supply, sewage and solid waste disposal, libraries and roads and other transportation infrastructure. Other important community services include electric and communications utilities. The provision of public services and the ability of service providers to adapt to change over time, or resulting from specific development activities, depend on a number of factors, including financial ability and community leadership. Public services are generally funded by tax revenues, although there may be other sources of revenue such as user fees or utility franchise fees. The tax base of the county or community where public services are provided is often a key component of the funding of public services. Information on public services and facilities for the Northern Cheyenne and Crow Reservations is presented under Social Organization in the Native American section of this chapter.

Attitudes, Beliefs, Lifestyles and Values

Information on general attitudes, beliefs, lifestyles and values in Montana and the general Planning Area as they relate to CBNG development has been gathered from public comment letters received during the scoping process for this project and also from past summaries in several related documents. While the generalized characterizations are not likely to apply to all individuals, the intention is to provide an idea of the range of the attitudes and lifestyles of the population subgroups present in the study area. See the Socioeconomics Appendix for detailed information.

The study area population is largely rural, with strong ties to the land and to the many small towns. Residents generally value the rural character of their lifestyle. Specific aspects of this lifestyle might include appreciation of wide-open spaces, natural landscape, fresh air and solitude. The lifestyle of rural communities often offers the desirable qualities of neighbors knowing each other, lack of urban problems, relaxed pace, personal freedom and being a good place to raise children. Longtime residents often want to see continued control of the land at the local level without interference from outside agencies or groups.

A portion of the population in the study area are Native Americans, who generally desire to preserve many elements of their heritage, express strong connections with the natural environment and often do not wish to become homogenized into the non-Indian culture. At the same time, some tribal members or subgroups are pursuing the development of energy resources for the long-term social and economic betterment of tribal members.

A small but growing population is made up of professionals, craftspeople, retirees and others who have moved to small towns to enjoy the slower pace of life and various amenities. While the forested areas of western Montana tend to attract more of this group than eastern Montana, these people are present in the study area as well. They may participate in opposition to development proposals that appear to jeopardize the quality of their new lifestyles.

Areas where energy resources are developed often see the influx of people from other areas. Many of these people regard their employment as temporary, expect to move on to other areas and do not play an integral part in community affairs. Long-term local residents often resent these "outsiders" while at the same time realizing some economic benefits from the business and service demands of these newcomers.

The vast majority of public comments on the Statewide Document received during the scoping process in early 2001 relayed concerns about potential impacts on water quality and quantity. Those who commented were most concerned with the discharge of water of poor quality (e.g., saline) and the drawdown of groundwater aquifers. Other concerns include possible increases in traffic levels, noise, visual resource impacts and psychological stress associated with change to the surrounding built and natural environment.

The comments reflect a difference in attitudes toward CBNG development among those individuals and organizations that might profit directly from CBNG and those that would not. The comments reflect a tension between the desire for new development to support the often stagnant rural economies and the concern that such development could harm the environment and the lifestyle qualities for which Montana is known, including natural beauty, wide-open spaces and solitude. Concerns were also expressed about potential adverse affects on the lifestyles of Native Americans, particularly those on the reservations. The comments reflect the traditional high value placed on natural resources by these groups, the importance of existing water and other natural resources in tribal economies and cultures and the opinion that tribal members will be unduly burdened with the costs of development while not receiving many or any benefits.

Scoping comments received in the summer of 2005 for this SEIS reflect similar concerns about and support for, CBNG development as those discussed above. In addition, there was a concern that delayed or phased development would create economic impacts. Specifically, lessees and lessors would lose revenue due to leasing and permitting delays and the state would have a net present value loss in income and payroll taxes, as well as production taxes and royalties. There were also concerns about the displacement of wildlife to livestock grazing tracts, the subsequent interference with livestock grazing and the potential effect on subirrigated tracts.

The Northern Cheyenne Tribe and others expressed concern that unrestrained CBNG development could lead to a boom and bust cycle. The fear is that this type of development could lead to adverse, long-term social and economic effects within the region. These adverse effects have been expressed as increases in population on the reservation, resulting in stress on tribal infrastructure and social services, as well as increases in teenage pregnancy, drug and alcohol use and crime.

Economics

Employment

Table 3-29 displays state employment by sector for the years 1990 and 1998 and Table 3-30 shows 1998 employment by sector within the Planning Area. In 1998, an estimated 543,333 people were employed in Montana, with 122,209 in the 13-county Planning Area. In 1998, employment in the Planning Area represented about 22 percent of the jobs in the state. Between 1990 and 1998, total employment in the state grew by 106,759, an increase of 24.5 percent. Employment in the 13-county Planning Area grew by 20,444 people, or 20.1 percent, during the same period.

TABLE 3-29
MONTANA EMPLOYMENT TRENDS BY SECTOR

	1990	1998	Change, 1990-1998	Percentage Point Change, 1990-1998
Farm Employment	30,576	32,071	1,495	4.9%
Non-Farm Employment				
Agriculture, Forestry,.Fishing and other	6,154	8,739	2,585	42.0%
Mining	7,824	6,730	-1,094	-14.0%
Construction	19,070	33,245	14,175	74.3%
Manufacturing	26,342	29,504	3,162	12.0%
Transportation and Public Utilities	23,858	26,759	2,901	12.2%
Wholesale Trade	17,449	20,693	3,244	18.6%
Retail Trade	78,715	106,202	27,487	34.9%
Finance, Insurance and Real Estate	27,693	34,673	6,980	25.2%
Services	118,623	161,740	43,117	36.3%
Government				
Federal, Civilian	13,771	12,647	-1,124	-8.2%
Military	10,516	8,474	-2,042	-19.4%
State	21,561	22,972	1,411	6.5%
Local	34,422	38,884	4,462	13.0%
Montana Total	436,574	543,333	106,759	24.5%

Source: U.S. Department of Commerce, BEA 2001.

TABLE 3-30

STATE EMPLOYMENT VERSUS PLANNING AREA EMPLOYMENT BY SECTOR (1998)

	Planning Area Employment by Sector	% of Planning Area Total by Sector	State Employment by Sector	% of State Total by Sector
Farm Employment	6,971	5.7%	32,071	5.9%
Non-Farm Employment				
Agriculture, Forestry, Fishing and other	1,476	1.2%	8,739	1.6%
Mining	1,996	1.6%	6,730	1.2%
Construction	6,776	5.5%	33,245	6.1%
Manufacturing	4,889	4.0%	29,504	5.4%
Transportation and Public Utilities	6,494	5.3%	26,759	4.9%
Wholesale Trade	7,107	5.8%	20,693	3.8%
Retail Trade	23,616	19.3%	106,202	19.5%
Finance, Insurance and Real Estate	7,654	6.3%	34,673	6.4%
Services	35,836	29.3%	161,740	29.8%
Government				
Federal, Civilian	2,902	2.4%	12,647	2.3%
Military	1,079	0.9%	8,474	1.6%
State	2,160	1.8%	22,972	4.2%
Local	10,675	8.7%	38,884	7.2%
Undisclosed or under 10 jobs	2,578	2.1%	N/A	N/A
Montana Total	122,209	100.0%	543,333	100.0%

Source: U.S. Department of Commerce, BEA 2001, 2005.

Montana's largest employment sectors in 1998 were services, retail trade and government; the smallest sector was mining. By far the fastest-growing sector between 1990 and 1998 was construction, which increased by 74.3 percent during the period. Other fast-growing sectors were agriculture, forestry and fishing services and retail trade.

Some sectors of state employment decreased between 1990 and 1998. Mining jobs decreased by 14 percent in the state, from 7,824 to 6,730. Overall, government jobs increased by only 3.4 percent; within that sector, military jobs decreased by 19.4 percent and federal civilian jobs decreased by 8.2 percent.

Tables 3-30 and 3-31 present state and Planning Area employment by sector. Table 3-30 shows that the economic base of the Planning Area by sector is very similar to the state as a whole. However, as indicated in Table 3-31, there is substantial variation among the sizes and strengths of the various economic sectors in the 13 Planning Area counties.

Unemployment

Table 3-32 presents the unemployment rate for Montana and each of the Planning Area counties in 1995 and 2000. In 1995, the average unemployment rates in Montana and in the Planning Area were essentially the same; 5.9 percent for the state and 5.8 percent for the Planning Area. In 2000, the average state unemployment rate had dropped to 4.9 percent while the average rate in the Planning Area decreased to 5.4 percent.

In 2000, unemployment rates in three of the Planning Area counties were higher than the 13-county average: Big Horn (14.4 percent); Musselshell (7.4 percent); and Rosebud (7.5 percent). Unemployment rates in each of the counties but Musselshell are explained in part by the high unemployment rates on the Indian reservations contained wholly or partly within these counties. As indicated in Table 3-18 (in the Native Americans section of Chapter 3), unemployment on the Crow and Northern Cheyenne Indian reservations in 1999 ranged between 14.9 percent and 18.7 percent. Consistent with trends in the rest of the state, the unemployment rate on each reservation fell between 1996 and 1999.

Unemployment rates on the reservations as measured by the Bureau of Indian Affairs are reported in Table 3-33. These rates are based on self-reported information from tribal leaders; 1999 is the latest year available. The rates calculated in this manner are substantially greater than those reported by the Montana Department of Labor and Industry (Table 3-32). They indicate unemployment at 61 percent for the Crow tribe and 71 percent for the Northern Cheyenne tribe. For all tribal members in Montana, the unemployment rate was 61 percent.

TABLE 3-31

PLANNING AREA EMPLOYMENT BY COUNTY AND SECTOR (1998)

Industry	Big Horn	Carbon	Carter	Custer	Golden Valley	Musselshell	Powder River	Rosebud	Stillwater	Sweet Grass	Treasure	Wheatland	Yellowstone
Farm Employment	13.2%	17.9%	44.4%	6.9%	41.7%	15.8%	33.8%	9.7%	14.3%	22.4%	40.6%	22.1%	1.6%
Non-Farm Employment													
Agriculture, Forestry, Fishing and other	3.0%	3.1%	a	1.5%	a	a	a	1.4%	2.5%	a	a	a	0.9%
Mining	8.7%	1.2%	a	b	0.0%	3.6%	1.7%	9.2%	a	b	0.0%	b	0.9%
Construction	3.3%	6.8%	a	a	a	6.5%	a	1.5%	5.1%	9.0%	a	a	6.4%
Manufacturing	1.2%	3.4%	1.9%	2.6%	a	5.8%	a	2.5%	8.9%	4.2%	0.0%	3.3%	4.3%
Transportation and public utilities	1.8%	2.2%	3.6%	a	b	4.3%	5.0%	12.0%	a	a	5.7%	2.7%	6.1%
Wholesale trade	1.5%	2.0%	0.0%	3.0%	a	a	1.0%	0.1%	1.6%	2.1%	a	a	7.6%
Retail trade	12.6%	18.6%	8.0%	22.6%	a	17.6%	13.1%	12.3%	14.5%	20.5%	12.2%	20.5%	21.1%
Finance, Insurance and Real Estate	3.7%	5.9%	2.2%	5.9%	0.0%	4.4%	1.7%	3.3%	3.8%	5.4%	a	3.9%	7.5%
Services	30.3%	27.0%	a	29.5%	a	23.9%	15.4%	34.0%	17.8%	16.3%	11.7%	22.5%	32.8%
Government													
Federal, Civilian	7.3%	1.4%	2.0%	4.7%	b	0.8%	1.4%	3.2%	0.8%	1.5%	1.1%	3.6%	2.0%
Military	1.2%	1.1%	1.0%	1.0%	b	1.3%	0.8%	1.0%	1.0%	0.9%	0.9%	1.1%	0.8%
State	0.8%	0.5%	0.3%	4.1%	b	0.8%	1.7%	0.6%	0.5%	0.8%	1.4%	0.7%	1.9%
Local	11.4%	8.9%	12.6%	7.7%	16.3%	10.8%	16.5%	9.3%	8.4%	12.2%	17.0%	12.7%	6.0%
Undisclosed or under 10 jobs	0	0	24.0%	10.4%	41.9%	4.2%	7.8%	0	20.9%	4.6%	9.4%	6.8%	0
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: U.S. Department of Commerce, BEA 2001.
a = Not shown to avoid disclosure of confidential information but the estimates for these items are included in the totals.
b = Less than 10 jobs but the estimates for these items are included in the totals.

TABLE 3-32

AVERAGE ANNUAL UNEMPLOYMENT RATES BY COUNTY

	1995 Rate (%)	2000 Rate (%)	Percentage Point Change, 1995-2000
Big Horn County	12.7	14.4	1.7
Carbon County	6.0	5.1	-0.9
Carter County	1.8	2.1	0.3
Custer County	4.6	4.3	-0.3
Golden Valley County	7.6	5.7	-1.9
Musselshell County	8.6	7.4	-1.2
Powder River County	2.4	3.0	0.6
Rosebud County	9.2	7.5	-1.7
Stillwater County	5.0	4.9	-0.1
Sweetgrass County	3.7	2.5	-1.2
Treasure County	3.5	5.0	1.5
Wheatland County	5.1	4.6	-0.5
Yellowstone County	4.8	3.8	-1.0
Planning Area Average	**5.8**	**5.4**	**-0.4**
Montana	**5.9**	**4.9**	**-1.0**

Source: Montana Department of Labor & Industry, Research & Analysis Bureau, Local Area. Unemployment Statistics (2001a).

TABLE 3-33

TRIBAL WORKFORCE AND UNEMPLOYMENT (1999)

Tribe	County	Total Tribal Enrollment	Available for Work of Total Work Force	Unemployed as % of Labor Force	Percent Employed but Below Poverty Guideline
Crow Tribe of Montana	Big Horn County	10,083	3,902	61%	38%
Northern Cheyenne Tribe	Big Horn County, Rosebud County	7,473	2,437	71%	26%
Montana (all tribes)		61,203	26,348	61%	33%

Source: U.S. BIA 1999.

Per Capita Income

Per capita income for the state of Montana and the counties in the Planning Area is shown in Table 3-34. In 1998, the average U.S. per capita income was $27,203 and the state average was $21,229. The average per capita income in the Planning Area was $17,715, only 83.4 percent of the state average. In 1998, per capita income in Yellowstone County was higher than the state average and incomes in Carbon, Custer and Stillwater counties were more than 90 percent of the state average. On the other hand, per capita income in three counties was substantially lower: Big Horn County (62.4 percent); Carter County (61.9 percent) and Musselshell County (67.6 percent).

TABLE 3-34
PER CAPITA INCOME, 1996-1998

	Dollars per Year			% Average Annual Increase (1996-1998)1	% of State Average (1998)
	1996	1997	1998		
Big Horn County	11,987	12,418	13,239	5.2%	62.4%
Carbon County	17,798	18,901	19,745	5.5%	93.0%
Carter County	11,793	12,480	13,139	5.7%	61.9%
Custer County	18,879	19,792	20,487	4.3%	96.5%
Golden Valley County	14,471	15,115	16,095	5.6%	75.8%
Musselshell County	13,087	14,047	14,351	4.8%	67.6%
Powder River County	13,593	15,061	16,314	10.0%	76.8%
Rosebud County	16,395	17,423	18,066	5.1%	85.1%
Stillwater County	18,114	18,726	19,736	4.5%	93.0%
Sweet Grass County	16,871	18,591	19,032	6.4%	89.7%
Treasure County	15,208	14,744	15,707	1.6%	74.0%
Wheatland County	14,784	16,695	16,217	4.8%	76.4%
Yellowstone County	22,173	23,168	24,425	5.1%	115.1%
Planning Area Average	**15,781**	**16,705**	**17,427**	**5.2%**	**82.1%**
Montana	**19,383**	**20,130**	**21,229**	**4.7%**	**100.0%**
U.S.	**24,651**	**25,924**	**27,203**	**5.0%**	

Source: U.S. Department of Commerce, Bureau of Economic Analysis 2001.
[1] 1996 to 1998 average annual increases corrected for rounding from original calculations.

Between 1996 and 1998, per capita income in the Planning Area increased by an average of 5.2 percent annually, slightly greater than in the state as a whole, in which per capita income increased by 4.7 percent. Per capita income increased in all of the Planning Area counties between 1996 and 1998.

Government Revenue Sources

Government revenues include taxes, royalties, fees and several other income sources. Please see the Socioeconomics Appendix for more information.

Taxes

Public finance mechanisms include taxes, royalties and other fees paid to local, state and federal governments. Taxes in Montana consist of property taxes, income taxes, natural resource taxes (coal, oil and natural gas) and selective sales taxes (cigarette and alcoholic beverages). There is no general sales tax in Montana. Table 3-35 shows total taxes collected in Montana. In 2004, more than $1 billion was collected in property taxes, accounting for 50.6 percent of the total state tax revenues collected. Income taxes were the second largest portion at 33.6 percent, followed by other taxes (8.4 percent) and natural resources (7.4 percent).

The taxes and royalties assessed on oil and gas development and production are an important source of revenue for local governments and the state of Montana. The oil and gas industry pays rents, royalties and bonuses on federal leases; production taxes on working and non-working interests in the state of Montana; and local property taxes on drilling and production equipment.

Generally, as county oil and gas production tax revenues increase (e.g., because of new oil and gas production), the property tax rate (mill levy) for the county is decreased accordingly. A percent of state-levied oil and gas production taxes are distributed to the counties based on the county where production occurred. For natural gas, 86 percent of the production taxes are distributed to the counties for local governments and schools. For oil, 60.7 percent of the production taxes are distributed to the counties. See the Socioeconomics Appendix for more information on taxes.

TABLE 3-35

TOTAL TAXES COLLECTED IN MONTANA (2004)

	2004 Tax Revenues Collected in Montana	Percent of Total
Property Taxes	$1,014,487,652	50.6%
Income Taxes	$673,071,361	33.6%
Natural Resource Taxes	$148,675,401	7.4%
Other Taxes	$168,133,456	8.4%
Montana Total	**$2,004,367,870**	**100.0%**

Source: Montana Department of Revenue (2004).

State Oil and Gas Lease Income

DNRC leases oil and gas, metalliferous and non-metalliferous, coal, sand and gravel mineral rights agreements on 6.2 million acres of school trust lands and more than 100,000 acres of other state-owned land throughout Montana. School trust lands are lands historically granted to the state of Montana to be used to support common schools and other educational and state institutions.

State mineral lease royalties are collected from production facilities located on state lands. Royalty payments are based on the volume of oil and gas produced and the price of the commodity. Rental and royalty revenues are either deposited into the appropriate permanent or distributable school trust or the state general fund. Table 3-36 presents the revenues received by the state in fiscal years (FY) 2000 and 2005 from minerals management, including leases (rents) and mineral production royalties on state trust lands. Oil and gas revenues in FY 2000 were $6.6 million, or 57.2 percent of total state mineral management revenues, while these revenues totaled $19 million, or 80.8 percent, in FY 2005. Oil and gas revenues comprised the largest share, with coal revenues the second largest, at 40.3 percent of the total for FY 2000 and 18.1 percent for FY 2005.

The state mineral leasing program includes 2,433 oil and gas leases, 534 of which are currently productive. From FY 1999 and FY 2000, the number of oil and gas leases increased by 8.1 percent and the number of productive leases increased by 14.3 percent. In FY 2000, state lands yielded 923,777 barrels of oil, 5,050,552 million cubic feet of gas and 375,113 gallons of condensate. Oil production declined 6.5 percent from FY 1999. However, the increase in average price from $10.50 per barrel in FY 1999 to $20.21 per barrel in FY 2000 accounted for the large increase in oil royalty revenue. Gas production in FY 2000 increased 19.6 percent, while price increased 36.0 percent compared to FY 1999, also resulting in a substantial increase in royalty revenue.

Federal Mineral Revenues

Oil and gas royalties are earned from production facilities on federal leases, units, or communitization agreements. Federal mineral lease royalties are collected on oil and gas produced based on the volume of product. Table 3-37 presents federal mineral revenue disbursements by county of origin for the 13 Planning Area counties and the state as a whole for FY 2000. Coal, gas and oil are the main mineral products. The totals reported do not include royalties and rents from leases on Native American tribal and allotted lands. For FY 2005, statewide revenue and disbursements are presented in Table 3-38. For the entire state of Montana, royalty values nearly doubled between FY 2000 and FY 2005 and disbursements to the state increased from $20 million to almost $36 million.

For FY 2000, mineral royalties from the 13 Planning Area counties totaled $29.8 million—approximately 69.5 percent of the $42.8 million collected in the state. Big Horn County accounted for a large share of the Planning Area revenues, with total royalties of $21.4 million, which were mostly from coal. Coal and oil revenues are far greater than gas revenues.

Formulas for disbursement of revenues from federal mineral leases are governed by legislation and regulations. Nationally, in fiscal year 2000, federal mineral lease revenues were disbursed as follows: 66.0 percent to the U.S. Treasury; 20.2 percent to special purpose funds, such as historic preservation, land and water conservation and reclamation; 10.8 percent to states; and 3.0 percent to Native

TABLE 3-36

REVENUES RECEIVED FROM MINERALS MANAGEMENT ON STATE LANDS IN FISCAL YEARS 2000 AND 2005

	FY 2000 Revenue (Dollars)	FY 2005 Revenue (Dollars)
Oil and Gas		
Rentals/Bonuses/Penalties	2,966,285	6,554,239
Royalties	3,684,595	12,546,646
Seismic Exploration	11,075	4,796
Subtotal	6,661,955	19,105,681
Percent	57.2%	80.8%
Aggregate Minerals		
Rentals	250	100
Royalties	245,693	227,171
Subtotal	245,943	227,271
Percent	2.1%	1.0%
Coal		
Rentals	44,371	40,057
Royalties	4,649,634	4,239,865
Subtotal	4,694,005	4,279,923
Percent	40.3%	18.1%
Other Minerals		
Subtotal	41,124	28,973
Percent	0.4%	0.1%
Rentals/Penalties	32,246	22,490
Royalties	8,878	6,483
TOTAL	11,643,027	23,641,848

Sources: MDNRC 2000 (http://www.dnrc.state.mt.us/trust/mmb.htm), MDNRC 2005 (http://dnrc.mt.gov/trust/MMB/Default.asp).

TABLE 3-37

ONSHORE FEDERAL MINERAL REVENUE DISBURSEMENTS IDENTIFIED BY COUNTY OF ORIGIN, FISCAL YEAR 2000, MONTANA[1]

	Product	Sales Volume	Royalty Value ($)	Disbursed to State ($)
Big Horn	Bonus		185,076	92,538
	Coal (ton)	20,416,210	20,912,616	10,456,308
	Gas (mcf)	44,411	4,028	2,014
	Other Revenues		16,562	8,281
	Rent		335,127	167,564
	Subtotal		21,453,409	10,726,705
Carbon	Gas (mcf)	166,547	45,722	22,861
	Gas Plant Products (gal)	2,789,164	89,617	44,809

TABLE 3-37

ONSHORE FEDERAL MINERAL REVENUE DISBURSEMENTS IDENTIFIED BY COUNTY OF ORIGIN, FISCAL YEAR 2000, MONTANA[1]

	Product	Sales Volume	Royalty Value ($)	Disbursed to State ($)
	Oil (bbl)	386,161	1,042,440	521,220
	Other Revenues		2,616,601	1,308,301
	Rent		76,892	38,446
	Sulfur (lton)	1,023	524	262
	Subtotal		3,871,797	1,935,899
Carter	Bonus		47,366	23,683
	Oil (bbl)	865	1,888	944
	Other Revenues		22,294	11,147
	Rent		90,429	45,214
	Subtotal		161,976	80,988
Custer	Bonus		51,904	25,952
	Gas (mcf)	56,563	11,875	5,938
	Other Revenues		1,135	568
	Rent		44,205	22,103
	Subtotal		109,119	54,560
Golden Valley			0	0
Musselshell	Bonus		594	297
	Oil (bbl)	5,378	2,394	1,197
	Other Revenues		1,077	539
	Rent		19,030	9,515
	Subtotal		23,095	11,547
Powder River	Bonus		39,028	19,514
	Gas (mcf)	14,352	4,076	2,038
	Oil (bbl)	74,079	172,508	86,254
	Other Revenues		6,796	3,398
	Rent		482,732	241,366
	Subtotal		705,139	352,569
Rosebud	Bonus		517,040	258,520
	Coal (ton)	1,612,516	1,852,468	926,234
	Oil (bbl)	21,613	42,355	21,178
	Other Revenues		690,601	345,301
	Rent		220,533	110,266
	Subtotal		3,322,997	1,661,499
Stillwater	Bonus		6,766	3,383
	Oil (bbl)	3,499	5,222	2,611
	Rent		26,077	13,039
	Subtotal		38,066	19,033
Sweet Grass	Bonus		8,928	4,464
	Rent		25,854	12,927
	Subtotal		34,782	17,391

TABLE 3-37

ONSHORE FEDERAL MINERAL REVENUE DISBURSEMENTS IDENTIFIED BY COUNTY OF ORIGIN, FISCAL YEAR 2000, MONTANA[1]

	Product	Sales Volume	Royalty Value ($)	Disbursed to State ($)
Treasure	Coal (ton)	97,143	118,745	59,372
	Rent		2,760	1,380
	Subtotal		121,505	60,752
Wheatland	Other Revenues		480	240
	Subtotal		480	240
Yellowstone	Oil (bbl)	1,648	2,494	1,247
	Other Revenues		516	258
	Rent		131	65
	Subtotal		3,140	1,570
Planning Area Total			**29,810,723**	**14,905,361**
% of State Total			**69.5%**	**73.1%**
Montana Total[2]			42,881,292	20,401,472

Source: U.S. Department of Interior, Minerals Management Service 2001.
[1]Does not include revenues collected from American Indian lands or offshore operations.
[2]Adjusted for net receipts sharing (less $1,039,174 disbursed to state).

mcf – thousand cubic feet
bbl – barrel
lton – long ton

TABLE 3-38

ONSHORE FEDERAL MINERAL REVENUE DISBURSEMENTS, FISCAL YEAR 2005, MONTANA[1]

Product	Sales Volume	Royalty Value ($)	Disbursed to State ($)
Coal (ton)	27,398,404	32,895,894	16,207,608
CBNG (mcf)	3,586,513	2,131,761	938,787
Condensate (bbl)	29,799	169,892	82,709
Drip or Scrubber Condensate (bbl)	868	4,143	496
Fuel Gas (mcf)	2,248	1,347	400
Gas Lost – Flared or Vented (mcf)	59,905	48,205	
Gas Plant Products (gal)	3,711,746	308,212	141,156
Oil (bbl)	4,255,590	22,080,910	8,281,428
Other Royalties		2,113,546	959,664
Processed (Residue) Gas (mcf)	438,035	245,717	71,863
Sulfur (long ton)	1,620	984	477
Unprocessed (wet) Gas (mcf)	26,302,336	15,417,717	6,307,602
Subtotal		**75,418,326**	**32,992,191**
Rents		3,809,836	1,653,314
Bonus		1,059,752	417,503
Other Revenues		970,906	499,298
Subtotal		**5,840,493**	**2,570,116**
Total		**81,258,819**	**35,562,307**

Source: U.S. Department of Interior, Minerals Management Service 2006.
[1]Does not include revenues collected from American Indian lands or offshore operations. Revenues and disbursements by county of origin are not available.

American tribes. This corresponds to $5.1 billion to the U.S. Treasury, $1.6 billion to special purpose funds, $843 million to states and $235 million to tribes. These disbursements were made to tribes that leased their land for minerals development.

Federal legislation provides that Montana receive 50 percent of the net receipts of all bonuses, rents and royalties collected on BLM-administered lands within Montana. As a result, the percentage of royalties disbursed in Montana is much greater than the national average. Of the $42.8 million in royalties collected on federal lands in Montana counties in 2000, nearly half, or $20.4 million, was disbursed to the state.

Statewide for FY 2005, the Minerals Management Service reported nearly 3,587,000 mcf of CBNG produced in Montana. This production generated $2.13 million in royalties, of which $939,000 was disbursed to the state (U.S. Department of Interior Minerals Management Service 2006).

Private Landowner Revenue

Some landowners in Montana own the mineral rights to their land and lease those rights for natural gas development and other uses. Landowners who do not own mineral rights may be subject to the development of natural gas or other energy or mineral resources on their land. Both of these categories of landowners receive income for use of their land, in the form of natural gas royalties or one-time compensation for land disturbance and use, respectively. This income is included in the total per capita incomes presented in Table 3-34.

Water Resource Values

Water plays an important role in the state and local economies of Montana. Water is a scarce resource in Montana—particularly in eastern Montana. Many of the state's surface water basins are over-appropriated and have been closed to future appropriations. In these locations, water users are turning more and more to groundwater to meet their water needs.

Most of the water used in the Planning Area is surface water (see Hydrology section of this chapter). Most of the surface water is from snowmelt and precipitation. Livestock watering and domestic water wells are the primary uses of groundwater in the area. Surface water and groundwater are also used for agricultural irrigation and surface water is used for recreation in some areas. Continued availability of adequate quantity and quality for these major uses is essential to maintaining the health of these sectors of the local and state economies.

The economic value of water resources for human uses varies greatly by location and by use and user. As an example, it has been estimated that the value of irrigation water to agricultural producers, based on the increase in production attributable to the use of the water for irrigation, is between $25 and $50 per acre-foot in eastern Montana (Schaefer 2001). Costs for domestic water would generally be more. The values are inherent components of the values of the various sectors of the economy, such as income from grazing and agriculture or costs of providing public water service. Changes in the supply or cost of water would contribute to changes in the costs and revenues for these activities.

Environmental Justice

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority and Low-Income Populations" (1994) requires the non-discriminatory treatment of minority populations and low-income populations for projects that occur on federal lands, require federal permits, use federal funds, or are otherwise under the jurisdiction of a federal agency. Disproportionately high or adverse health or environmental effects on such populations must be identified and addressed as appropriate.

Native Americans are environmental justice populations represented in the Planning Area. Information on the Northern Cheyenne and Crow tribes is provided in the *Demographics*, *Social Organization* and *Economics* subsections of this section. In addition, information on the Northern Cheyenne and Crow Indian Reservations is provided in the *Indian Trust Assets* and *Native American Concerns* sections of this chapter.

Low-Income and Minority Populations

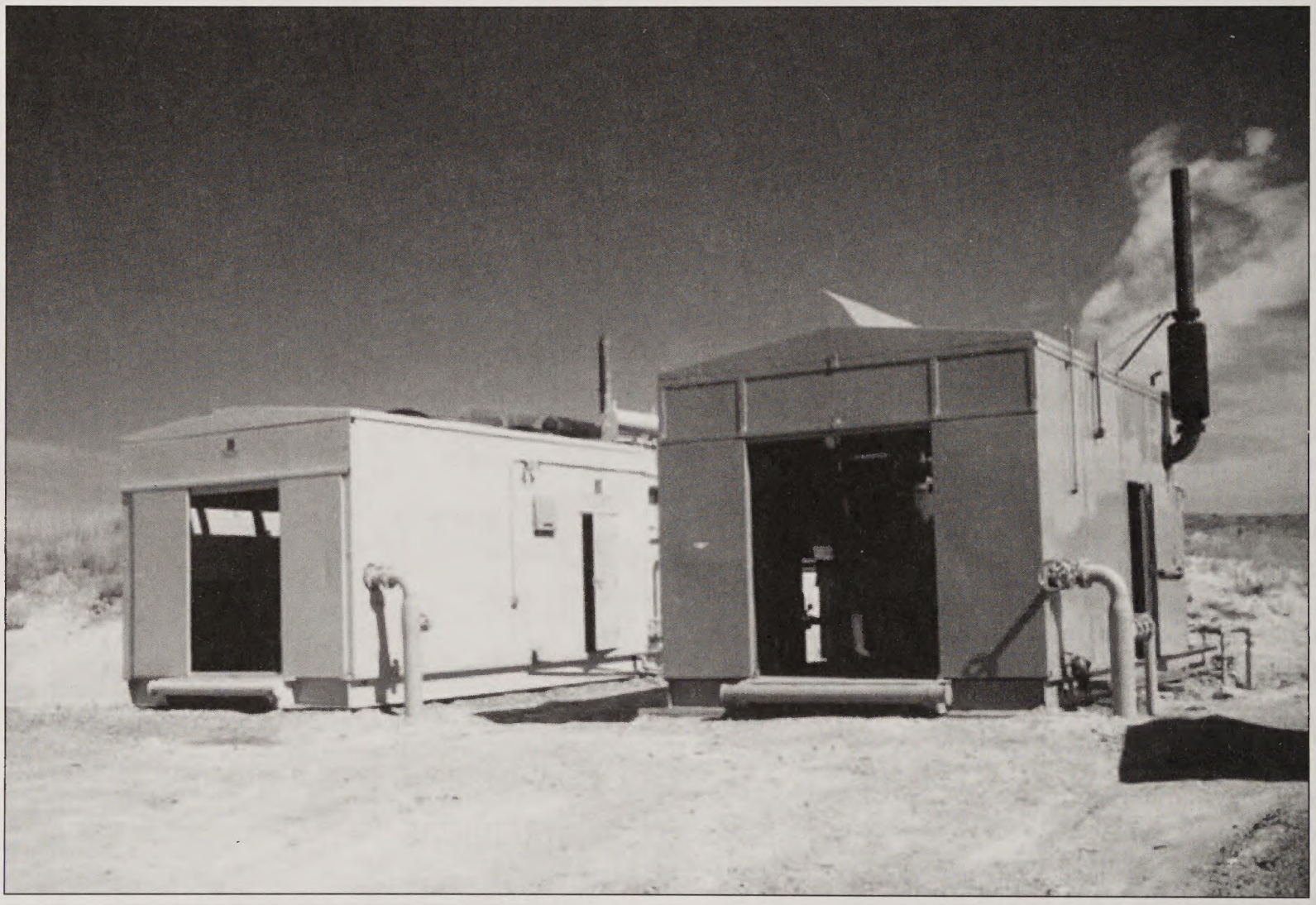
This section describes locations of concentrations of minority populations and low-income populations at the county level, in accordance with the scope of this study. Potential sub-county concentrations of minority populations and low-income populations are also possible but could only be identified on a project-specific basis. The occurrences of minority populations and low-income populations are discussed in detail in the Demographics section of this report and are presented in Tables 3-26 and 3-27, respectively.

The Montana population is 90.6 percent white, similar to the 13-county Planning Area, which is 88.8 percent white. While 11 of the 13 Planning Area counties are between 92.8 percent and 99.1 percent

white, two of the counties—Big Horn and Rosebud—include Indian reservations with substantial Native American populations. Big Horn County, where the population is 59.7 percent Native American, includes most of the Crow Reservation and part of the Northern Cheyenne Reservation. Rosebud County also includes part of the Northern Cheyenne Reservation and is 32.4 percent Native American. Bighorn and Rosebud counties are two of the counties with the most potential for CBNG activity.

The percentage of the Montana population living in poverty is 15.5 percent; the average in the 13-county Planning Area is 14.3 percent. The Planning Area contains 27,934 persons below the poverty level, or about 20.6 percent of the state's total below the poverty level. Nine of the 13 study-area counties have poverty rates greater than the state average. The county with the highest rate is Big Horn, where more than one quarter of the population had an income below the poverty level in 1997.

An Amish community located along the Tongue River north of Ashland in Rosebud County could be considered a low-income population. This small community consists of 15 people (BLM 2003).



Two typical field compressors. These four-stage, 6.0 million cubic foot per day, reciprocal compressors operate at 380 horsepower and use natural gas as a fuel.

Soils

Montana, with its wide mix of geologic parent material, has a vast array of different soil types. Differences in climate, parent material, topography and erosional conditions result in soils with diverse physical and chemical properties. The distribution and occurrence of soils can be highly variable and is dependent on a number of factors including slope, geology, vegetation, climate and age. All areas covered by the Billings and Powder River RMPs have had soils mapped. Soil surveys in some areas are currently being updated. More detailed information is available from Soil Survey Geographic Databases (SSURGO) at http://www.ncgc.nrcs.usda.gov/products/datasets/ssurgo/index.html. Interpretations and physical and chemical characteristics of soils, can be found in the Soils Appendix.

The five major soil forming factors are as follows (Brady 1990):

1. Climate—particularly temperature and precipitation.
2. Living Organisms—especially native vegetation, microbes, soil animals and human beings.
3. Nature of parent material.
4. Topography of the site.
5. Time that parent materials are subject to soil formation.

Soils in the RMP areas are derived mainly from sedimentary bedrock and alluvium. The soils generally range from loams to clays, but are principally loams to silty clay loams.

Soil salinity affects the suitability of a soil for crop production and the stability of the soil. The SAR is the measure of sodium relative to calcium and magnesium and affects the soil structure and infiltration rate of water. The Soils Technical Report presents a more detailed discussion pertaining to the salinity and SAR of the soils in the Billings RMP and Powder River RMP areas. A summary of this report is presented in the Soils Appendix.

Irrigated Soils

Virtually all of the irrigated lands are currently located in the river and stream valleys. Some dry farming occurs on the higher terraces above the valleys. Some of the land next to the rivers and major tributaries is irrigated for wheat, feed grains, alfalfa, grass hay, sugar beets and tame pasture (BLM 1992). However, most of the area is native range used for grazing livestock.

The principal irrigated crops grown in the study area and their estimated acreages are shown below:

PRINCIPAL CROPS IN STUDY AREA

Crop	Irrigated (acre)	Non-Irrigated (acre)
Wheat	17,200	535,100
Barley	27,800	95,700
Oats	5,000	15,400
Corn	37,600	0
Sugar Beets	26,200	0
Alfalfa	139,500	279,500
Grass Hay	49,500	126,500

Source: Montana Department of Agriculture, Agricultural Statistics (2000) for 1999 Crop Year.

Solid and Hazardous Wastes

The BLM's hazardous materials program priorities are to protect the public health and safety; protect natural and environmental resources; comply with applicable federal and state laws and regulations; and minimize future hazardous substance risks, costs and liabilities on public lands. BLM is responsible for all releases of hazardous materials on public lands and requires notification of all hazardous materials to be used or transported on public land.

Solid and hazardous wastes can be generated during oil and gas and CBNG activity. These wastes are under the jurisdiction of the MDEQ for Resource Conservation and Recovery Act (RCRA) wastes; the MBOGC for RCRA-exempt wastes such as drilling wastes; and the EPA on tribal lands. At the present time, wastes generated from the wellhead through the production stream to and through the gas plant are exempt from regulation as a hazardous waste under RCRA's exploration and production exemption, but are covered by mineral leasing regulations.

The exemption does not apply to natural gas as it leaves the gas plant for transportation to market. Releases must be reported in a timely manner to the National Response Center the same as any release covered under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Prior to a gas plant, releases are reported to the BLM via a Report of Undesirable Event (NTL-3A; 43 CFR 3162.5-1(c)). The BLM requires immediate reporting of all Class I events, which involve the release of more than 100 barrels of fluid/500 MCF of gas, or fatalities. The MDEQ's Waste and Underground Tank Management Bureau is responsible for administering both the Montana Solid Waste Management Act (75-10-201 *et seq.*, MCA) and the Montana Hazardous Waste Act (75-10-401 *et seq.,* MCA).

It has been established by CERCLA that the owner of the land is ultimately responsible for hazardous materials or substances placed or released on their lands. Under CERCLA, the term "hazardous substance" is typically any toxic, corrosive, ignitable, explosive, or chemically reactive substance, but does not include petroleum, crude oil, natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel, or mixtures of natural gas and synthetic gas. According to MCA 82-10-505: the oil and gas developer or operator is responsible for all damages to property, real or personal, resulting from the lack of ordinary care by the oil and gas developer or operator. The oil and gas developer or operator is responsible for damages to property, real or personal, caused by drilling operations and production. This places the liability of any cleanup that results from spills or unused non-exempt waste and the removal of such waste (paint, acid, or other chemicals) to the oil and gas developer and operator. The oil and gas industry transports hazardous materials on the highways, stores and uses the materials at the sites and produces some hazardous wastes, such as paint waste from the painting of facilities and unused acid or chemicals that were not used in well treatments. This presents a potential for spills, leaks and illegal disposal. Reserve pits may be required to be lined, which reduces but does not eliminate leaks. Produced water is the predominant fluid, but some hazardous substances also are released. The content of the releases or spills will be varied and unpredictable.

The transportation of hazardous materials is regulated by Montana's Department of Transportation (MDT) under CFR Parts 171-180. These regulations pertain to packing, container handling, labeling, vehicle placarding and other safety aspects. The transportation of all hazardous waste materials in Montana must comply with the Federal Motor Carrier Safety Regulations, part 390 through part 397.

The EPA requires manufacturers to report releases of more than 600 designated toxic chemicals into the environment. EPA compiles this data in an annual Toxics Release Inventory. Toxics Release Inventory facilities are required to report on releases of toxic chemicals into the air, water and land. In addition, they report on offsite, pollution prevention activities and chemical recycling. The Toxics Release Inventory also provides information about potentially hazardous chemicals and their use; however, the law does not cover toxic chemicals that reach the environment from non-industrial sources, such as dry cleaners or auto service stations.

In 1998, EPA added seven new industries to the Toxics Release Inventory: metal mining, coal mining, electrical utilities that combust coal or oil, RCRA Subtitle C hazardous waste treatment and disposal facilities, chemicals and allied products wholesale distributors, petroleum bulk plants and terminals and solvent recovery services. There are currently (as of the end of 2003, the period for which the most recent data are available) eight facilities in the RMP areas that report Toxics Release Inventory information to the EPA, with most of them being related to the energy and mining industries. The Solid and Hazardous Waste Appendix contains *the Toxics Release Inventory for Montana.*

Vegetation

The land classification system developed by the University of Montana for the Montana Gap Analysis (MT-GAP) is used for this discussion because it has a large amount of detailed information about vegetation and wildlife distribution. All classification descriptions are from the MT-GAP project and acreage estimates and calculations are based on their data results (Fisher et al. 1998).

The Planning Area includes six general land classes or vegetative communities: Agriculture/Urban Areas, Grassland, Shrubland, Forests, Riparian Areas and Barren Lands. (Non-riparian wetlands are also present but are widespread and generally in relatively small areal units compared to other land classes, so are not defined separately.) The six general land classification descriptions and their subdivisions will be explained in more detail below. All of these habitats are important to a wide variety of wildlife species.

Plant Communities

Grasslands

Grasslands are among the most biologically productive of all vegetative communities because of soil nutrient retention and fast biological recycling. They are also very valuable because the vegetation is nutritious and used by livestock and by a large constituent of wildlife (Williams and Diebel 1996; Estes et al. 1982). Grassland sites are dominated by herbaceous canopy cover at greater than 15 percent, shrub cover at less than 15 percent and forest cover at less than 10 percent (Fisher et al. 1998).

Grasslands cover an estimated 7.9 million acres of the 13 counties that make up the SEIS Planning Area. This is almost twice as much land as any other vegetation type in the Planning Area. Those grasslands with underlying subbituminous or bituminous coal deposits cover 1.5 million acres of the Powder River RMP area and 1 million acres of the Billings RMP area. For grassland types, see the Vegetation Appendix.

Shrublands

Shrublands are characterized by shrub covers greater than 15 percent and forest cover less than 10 percent (Fisher et al. 1998). This vegetation type is dominant on approximately 4.8 million acres of the Planning Area. Of this, 1.7 million acres are underlain by subbituminous or bituminous coal deposits. Important shrubs include several species of sagebrush (*Artemisia nova*, *A. tridentata* ssp. *tridentata*, *A. tridentata* ssp. *vaseyana*, *A. cana* and *A. tridentata* ssp. *wyomingensis*) and shadscale (*Atriplex confertifolia)* or fourwing saltbush (*Atriplex canescens*). Other important shrub species in this category are bitterbrush (*Purshia tridentata*), creeping juniper (*Juniperus horizontalis*), greasewood (*Sarcobatus* spp.), mountain mahogany (*Cercocarpus* spp.), rabbitbrush (*Chrysothamnus* spp.) and shadscale (*Atriplex canescens*). These shrublands are often associated with a complex of understory grasses such as bluebunch wheatgrass (*Agropyron spicatum*), blue grama (*Bouteloua gracilis*), Idaho fescue (*Festuca idahoensis*), needle and thread (*Stipa comata*) and western wheatgrass (*Agropyron smithii*).

Forests

Land is classified as forest if it has more than 10 percent tree cover. Montana has 19 categories of forests under this classification. Within the Planning Area, 2.8 million acres are classified as forest. Of that, almost 1.3 million acres are underlain by subbituminous or bituminous coal deposits. Two forest types account for the majority of the forested areas within the Planning Area: Ponderosa Pine Forests and Low-Density Xeric Forests. Ponderosa Pine sites are dominated by ponderosa pine (*Pinus ponderosa*) at 20 to 80 percent cover. They are associated with big sagebrush, ninebark, snowberry, bluebunch wheatgrass, blue grama and Idaho fescue. Low-density xeric forests have tree cover at 5 to 20 percent with a grass understory. Dominant tree species are Douglas fir, limber pine, ponderosa pine, Rocky Mountain juniper, or Utah juniper (Fisher et al. 1998).

Riparian Areas

These are sites that are associated with intermittent and perennial water sources or with woody draws. Riparian areas are classified as Conifer, Broadleaf, Mixed Broadleaf and Conifer, Graminoid and Forb, Shrub and Mixed (Fisher et al. 1998). All riparian types have high species richness, which reaffirms why riparian sites are considered to be some of the most biologically diverse habitats anywhere.

Other Wetlands

Wetlands not associated with streams or rivers (riparian) are found in many low areas across Montana. In general, these wetlands (palustrine) are dominated by either emergent marsh vegetation, such as cattails, sedges and/rushes, or by shrub vegetation, such as willows. Forested wetlands many also be present in some areas.

Barren Lands

These are sites with less than 10 percent forest cover, less than 10 percent shrub cover and less than 10 percent herbaceous cover (Fisher et al. 1998). The

category name may imply that these areas have no biological value, but this would be misleading.

Noxious Weeds

Noxious weeds are generally non-native plants designated by federal, state, or local governments that can be directly or indirectly injurious to public health, agriculture, livestock, navigation, recreation, fish, wildlife, or property (Sheley et al. 1999; Montana Summit Steering Committee and Weed Management Task Force 2005). In disturbed areas, noxious weeds readily establish and may out-compete native plants. Once established, they can spread by aggressive vegetative growth and advantageous seed dispersal mechanisms. They are generally unpalatable, potentially toxic and highly competitive in native rangeland and riparian habitats.

An indicator of the extent of exotic or introduced species, including noxious weeds, in the Planning Area was derived from the Montana GAP Analysis. MT-GAP was described previously under plant communities. The altered herbaceous habitats cover type includes areas dominated by noxious weeds and old agricultural field areas previously planted for pasture with crested wheatgrass (*Agropyron cristatum*) and yellow sweet-clover (*Melilotus officinalis*). The altered herbaceous habitats cover type encompasses approximately 36,969 acres underlain by subbituminous or bituminous coal beds in the Planning Area. This estimate includes land altered by exotic or introduced species and it is larger than surveyed areas for state-listed noxious weeds. The list of state of Montana noxious weeds is provided in the Vegetation Appendix (Table VEG-7). Detailed noxious weed surveys have been conducted for only small portions of the Planning Area.

Since the spring of 2003, the state of Montana has increased the listed number of noxious weeds to 31 from the 26 reported in the original EIS. The noxious weeds are divided into three categories. Category 1 species are currently established and widespread in many counties. Category 2 weeds are recently introduced and are rapidly spreading. Category 3 weeds are either not detected in Montana, or are usually found in small localized infestations. The Invaders Database at the University of Montana (2004) is an electronic database of noxious weeds in Montana. In the state, there are 15 plants classified as Category 1 noxious weeds (Table VEG-7).

Noxious weeds surveys were last reported in the Planning Area in 2002. Many of these weed occurrences were recorded during an extensive survey of weed populations conducted in 2002 along the Yellowstone River in Yellowstone County within the Billings RMP area. Approximately 2,690 weed occurrences were reported, covering approximately 1,900 acres. In addition, 8 and 20 acres of noxious weeds were found in Carbon and Stillwater Counties, respectively, within the Billings RMP area. A few additional occurrences of noxious weeds, totaling 2 acres, have been reported in Treasure County within the Powder River RMP area.

See the Vegetation Appendix for a complete list of noxious weeds for Montana.

Species of Concern

Federally listed plant species have been designated as either threatened, endangered, or candidate species of concern under ESA. The MNHP (2005) did not report any federally listed plants currently present within the Planning Area.

State Species of Concern

In addition to species that are federally protected under the ESA, the state of Montana has designated additional species of concern within its jurisdictional boundaries. There are five rankings for State Species of Special Concern. This document focuses only on the highest ranking (S1). This ranking is defined as critically imperiled because of extreme rarity (five or fewer occurrences, or very few remaining individuals), or because some factor of its biology make it especially vulnerable to extinction.

Special status or sensitive plant species on BLM-administered lands are managed through guidelines in Section 6840 of the BLM Manual. Sensitive species are those thought to be rare or imperiled by proper study and have been documented on BLM-administered land. Seven criteria outlined in Section 6840 are used to determine whether a species is at risk. The sensitive species designation is used to provide conservation actions for species to preclude the need for listing and to improve the status of species to the point where special status recognition is no longer warranted (BLM 2005a).

The Montana NHP maintains the statewide rare plant database for the state of Montana. Table VEG-8 includes BLM, USFS and state species of concern identified by Montana NHP on September 23, 2005. State-listed species (with BLM and Forest Service rankings) that have potential distributions within the 13-county Planning Area are listed in the Vegetation Appendix (see Table VEG-8). The Vegetation Appendix also includes the type of habitat where they are likely to be found (Montana NRIS 2001). Table VEG-6 links wildlife species to habitat requirements.

The Montana NHP (2005) reported 45 BLM sensitive plant species of concern that occur in the Planning

Area. Thirteen USFS sensitive plant species also occur within the Planning Area (Table VEG-8). In addition, detailed surveys were conducted in selected areas in Rosebud (Barton and Crispin 2003), Big Horn (Carlson and Cooper 2003) and Powder River counties (Heidel et al. 2002). These studies identified several new occurrences of various BLM sensitive species in these areas.

The large geographic area of the Planning Area supports a variety of habitats that support special status species. Currently, there are 83 state-listed species of concern in the 13-county Planning Area (Table VEG-8). Most occurrences (42) have been documented in Carbon County. Conversely, only one special status species occurs in Golden Valley and in Musselshell counties.

Thirteen special-status species have been reported in Big Horn County, while nine occur in both Powder River and Rosebud counties. This disparity in species occurrences reflects the degree of diversity of habitats in the area, but also may result from less extensive field surveys conducted in some areas. Fifteen species of concern are restricted to alpine habitats, which would not be affected by CBNG development. Historic maps for most species of concern show much wider distributions than present distributions.

Visual Resource Management

Visual resources are visual features in the Montana landscape that include landform, water, vegetation, color, adjacent scenery, uniqueness or rarity, structures and other man-made features. The 13 counties in the Planning Area portray a variety of landscapes and habitats, all with different visual qualities. Current visual resource management is in accordance with the two RMPs. The four classes are as follows:

- Class I—preserve the existing character of the landscape
- Class II—retain the existing character of the landscape
- Class III—partially retain the existing character of the landscape
- Class IV—provide for management activities that require major modifications to the existing character of the landscape

Non-federal land is not under any visual resource management system although there are often visual quality concerns. Federally authorized projects, however, undergo a visual assessment to comply with aesthetic requirements. Typically, sensitive areas include residential areas, recreation sites, historical sites, significant landmarks or topographic features, or any areas where existing visual quality is valued.



Three CBNG well heads forming a field pod near Decker, Montana. Each well is drilled to a different depth and into a different layer of coal.

Wilderness Study Areas

Six wilderness study areas (WSA) are within the Planning Area:

- Carbon County
  - Burnt Timber Canyon WSA
  - Pryor Mountain WSA
  - Big Horn Tack-On WSA
- Golden Valley County
  - Twin Coulee WSA
- Rosebud County
  - Zook Creek WSA
- Powder River County
  - Buffalo Creek WSA

Monitoring reports for these WSAs list little or no activity with the exception of some minor vehicle tracks found in the Pryor Mountain WSA, Big Horn Tack-On WSA and Burnt Timber Canyon WSA.

Wildlife

The SEIS Planning Area covers a large portion of southeast and south central Montana and includes substantial geographic and topographic variation and a wide variety of plant communities and wildlife habitat types. This combination of factors results in diverse wildlife communities, with some species having widespread occurrence throughout the Planning Area and others being restricted to one or a few specialized habitats and locations.

The Vegetation section described the predominant native plant communities that provide habitat for wildlife in the Planning Area. These include a variety of grassland, shrubland, forest and riparian habitat types. Drier grasslands and shrublands are dominant with breaks, badlands, coulees, wooded draws, open conifer forests and riparian shrub and forest communities along perennial and intermittent drainages. Two other cover types present in the Planning Area include open water and a variety of agricultural land uses, both of which provide important habitat value to certain species during some seasons. Additionally, special habitat features such as cliffs, snags, springs, natural potholes, reservoirs, lakes and islands are present in the Planning Area.

Mammals

The variety of locations, topography and cover types in the Planning Area support many mammal species. The MT-GAP atlas of terrestrial vertebrates (MT-GAP 1998) shows the known distribution of vertebrates in Montana. It indicates the Planning Area supports 10 species of bats; 8 species of shrews; 34 other species of small mammals and lagomorphs; 17 omnivores or predators ranging in size from the least weasel (*Mustela nivalis*) to the black bear (*Ursus americanus*) and mountain lion (*Felis concolor*); and 5 to 7 big game species. Several of these species have suffered substantial habitat loss and population decline and are considered to be rare or are protected by federal statutes. These species are addressed in the Species of Concern (SOC) section.

Some of the more common predators include the coyote (*Canis latrans*), red fox *(Vulpes vulpes*), raccoon (*Procyon lotor*), badger (*Taxidea taxus*) and striped skunk (*Mephitis mephitis*). Local occurrence of these and other predators varies by habitat type.

Big game species common within parts or all of the Planning Area include elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*) and pronghorn (*Antilocapra americana*). The MT-GAP (1998) provides the following summary of habitat preferences for these species.

Elk habitat preference is described as including moist sites during the summer. Elk use open areas such as alpine pastures, marshy meadows, river flats and aspen parkland as well as coniferous forests, brushy clearcuts and forest edges. High-quality winter range is critical to long-term elk survival. The distribution of elk winter habitat in the planning area is shown on Map 3-12.

Mule deer are the most widely distributed big game species in Montana and occupy a wide range of habitat types during the year. Breaks, badlands and brushy draws are preferred in open prairie country. McCracken and Uresk (1984) reported that both hardwood and pine forests were important to mule deer in southeastern Montana, with hardwood forests preferred. The Billings RMP (BLM 1983) indicates that although mule deer occur throughout the Planning Area, they are more abundant in the open shrub-grassland habitats adjacent to timbered or broken terrain. Habitat such as riparian bottoms, agricultural areas and forests are used as well, either year long or seasonally. Winter ranges are typically at lower elevation than summer ranges and are often dominated by shrub species that provide crucial browse. The distribution of mule deer winter range in the Planning Area is shown in Map 3-13.

In the Powder River RMP area, mule deer use all habitat types, but generally prefer sagebrush, grassland and conifer (BLM 1984b). Broken terrain provides important cover in these habitats (Hamlin 1978). Browse is an important component in the mule deer annual diet. Observations by the Montana Department of Fish, Wildlife and Parks (Youmans et al. 1982), indicated 73 percent of the mule deer observed in winter concentration areas in southeastern Montana were in rough topography, especially in pine-dominated habitats. However, along the Powder and Little Missouri Rivers, however, riparian habitat accounted for 94 percent of the wintering mule deer concentrations, probably due to the lack of rough breaks. These habitats are crucial to herd survival in the Powder River RMP area. There appears to be little or no seasonal migration of mule deer in southeastern Montana (BLM 1984b). The Wildlife Surveys and Monitoring since the Statewide Document section provides information on the number of mule deer and other ungulates observed on the southern portion of the Northern Cheyenne Reservation and in the Planning Area.

White-tailed deer also occur throughout Montana but are more restricted by habitat preference than are mule deer. Preferred habitats include forest types, agricultural fields and prairie areas adjacent to cover. Mesic areas such as riparian areas and montane forests are preferred in the drier portions of central and eastern

Montana. McCracken and Uresk (1984) reported a strong preference for hardwood forests in southeastern Montana. During the winter, white-tailed deer using forested areas prefer dense canopy classes, moist habitat types, uncut areas and low snow depths. Suitable winter range is a key habitat factor for white-tailed deer and winter concentration areas occur almost exclusively in riparian-wetland habitats and in dense pine (Youmans and Swenson 1982). Although white-tailed deer move on and off winter range, as dictated by seasonal habitat requirements, the animals do not migrate long distances (Hamlin 1978). The distribution of white-tailed deer winter habitat in the PRB is shown on Map 3-14.

Pronghorn are relatively common throughout eastern and central Montana and occupy a variety of grassland and shrubland habitats on prairies, semi-desert areas and foothills. Summer habitat preferences are reported to include mixed shrub communities, perennial grasslands, silver sagebrush stands, annual forblands and croplands (Armstrup 1978; Wentland 1968). McCracken and Uresk (1984) reported a strong preference to sagebrush-grassland cover types in southeastern Montana. Sagebrush-grasslands with shrubs 12 to 24 inches tall are preferred in the winter when sagebrush composes a significant portion of the pronghorn diet (Bayless 1967). The distribution of pronghorn winter habitat in the PRB is shown on Map 3-15.

The range of moose (*Alces alces*) overlaps with coal-bearing lands in Carbon County. Moose habitat generally consists of a mosaic of second-growth forest, openings, swamps, lakes and wetlands. Water bodies are required for foraging and hardwood-conifer forests provide winter cover. Willow flats may provide yearlong habitat in some areas (Stone 1971) and closed canopy stands may be important in late winter (Mattson and Despain 1985).

The other two big game species that may occur in the Planning Area include the mountain goat (*Oreamnos americanus*) and Rocky Mountain Bighorn Sheep (*Ovis canadensis*). Mountain goats typically occupy alpine and subalpine habitats, steep grassy talus slopes, grassy ledges and cliffs, or alpine meadows. Both mountain goats and mountain sheep may overlap with coal-bearing lands in southwestern and southern Carbon County, respectively. The Pryor Mountain bighorn herd, which occurs south of Billings, is estimated at 125 to 150 individuals as of the 2005/2006 winter index count conducted by MFWP (Stewart, 2006). Grasses and forbs provide the major portion of their yearlong diet, which is supplemented with browse types such as curlleaf mountain mahogany and sagebrush (USFWS 1978). Little information is currently available on the migratory routes of this herd.

In eastern Montana, most mule deer and elk winter range is located on relatively large areas of land with a diversity of slopes, aspects and topographic features (MBOGC 1989). Winter range is often part of year-round habitat.

Prairie dog towns provide habitat for more than 163 vertebrate species, including several rare or endangered species such as the burrowing owl (*Athene cunicularia*), swift fox (*Vulpes velox*), mountain plover (*Charadrius montanus*) and black-footed ferret (*Mustela nigripes*), an endangered species (Reading et al. 1989, Koford 1958, Tyler 1968, Campbell and Clark 1981, Clark et al. 1982 and Agnew 1983). Most prairie dog towns in the Planning Area are composed of black-tailed prairie dogs (*Cynomys ludovicianus*); white-tailed prairie dogs (*C. leucurus*) are found only along the Clarks Fork of the Yellowstone River in Carbon County, which is at the northern limit of its range.

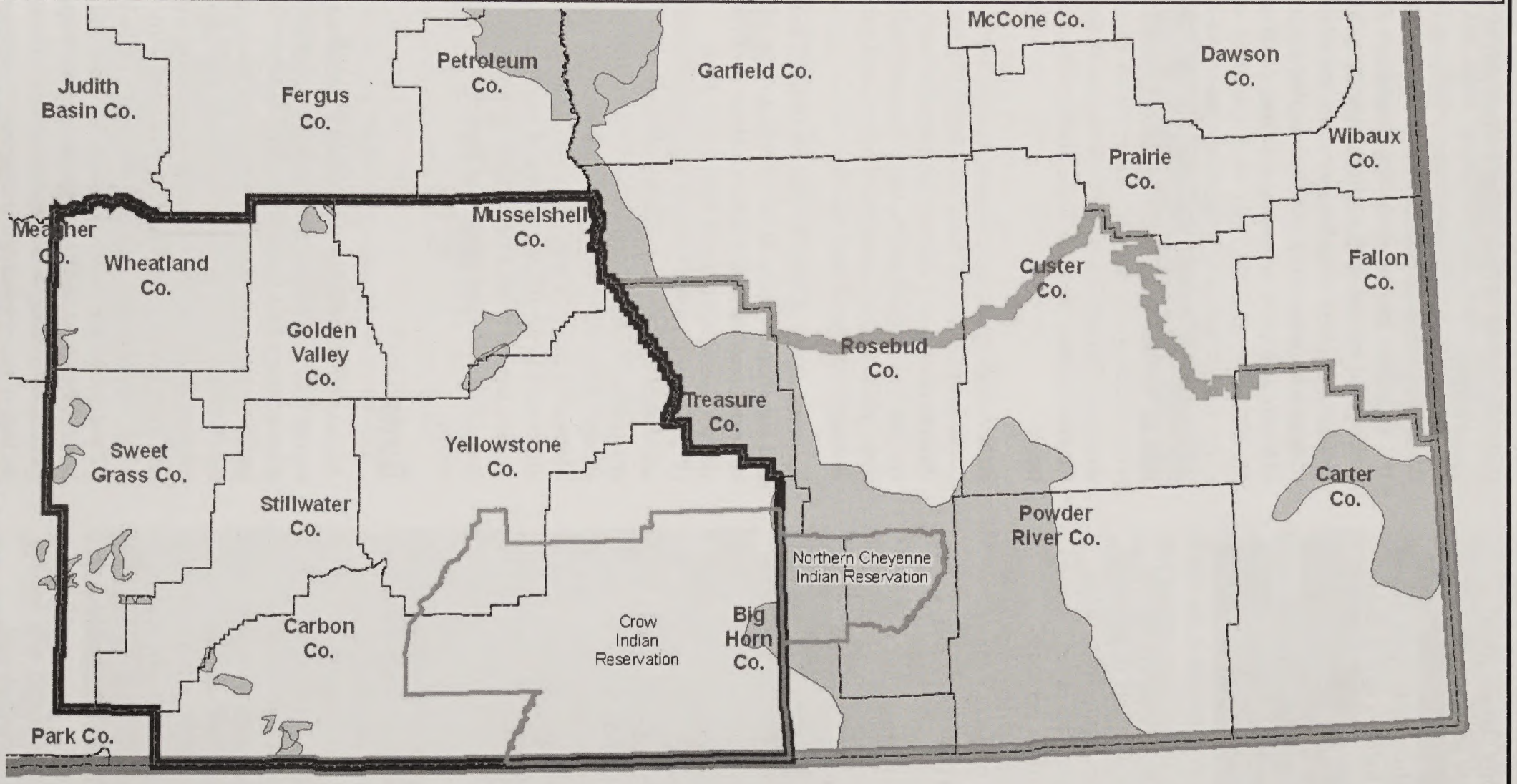
As noted above, at least 10 species of bats probably occur in the Planning Area. Additional species migrate through central and eastern Montana. Habitat varies by species and includes caves, large-diameter hollow trees, old buildings, abandoned mines, rock crevices and under the loose bark on large trees.

As noted above, at least 42 species of small mammals and lagomorphs occur in the Planning Area. MFWP has expressed particular concern about the Preble's shrew (*Sorex preblei*) and Merriam's shrew (*S. merriami*). Preble's shrew has a spotty distribution associated with dry sagebrush and sagebrush grasslands (Hoffman and Pattie 1968) and riparian shrubs (Allen et al. 1994, Ports and George 1990). Merriam's shrew is apparently somewhat more widely distributed in the Planning Area. It occupies the same general habitat types as the Preble's shrew plus grasslands and open ponderosa pine stands (MT-GAP 1998).

Birds

As noted for mammals, the variety of locations, topography and cover types in the Planning Area also support many bird species. The MT-GAP (1998) indicates that more than 250 species of birds occur in the Planning Area. Some are yearlong residents; a few migrate south into the Planning Area during the winter and most breed in the Planning Area and winter to the south. Approximate numbers of species include 32 waterfowl and related species; 33 shore and wading birds; 18 diurnal and 11 nocturnal raptors; 8 species of gallinaceous birds; 8 woodpeckers; and 137 songbirds, including many neotropical migrants. Species richness and breeding bird densities are highest in riparian woodlands and wetland habitats.

Map 3-12: Elk Winter Range in the CBNG Planning Area



Legend

- Elk Winter Range
- American Indian Reservations
- Billings RMP Area
- Powder River RMP Area

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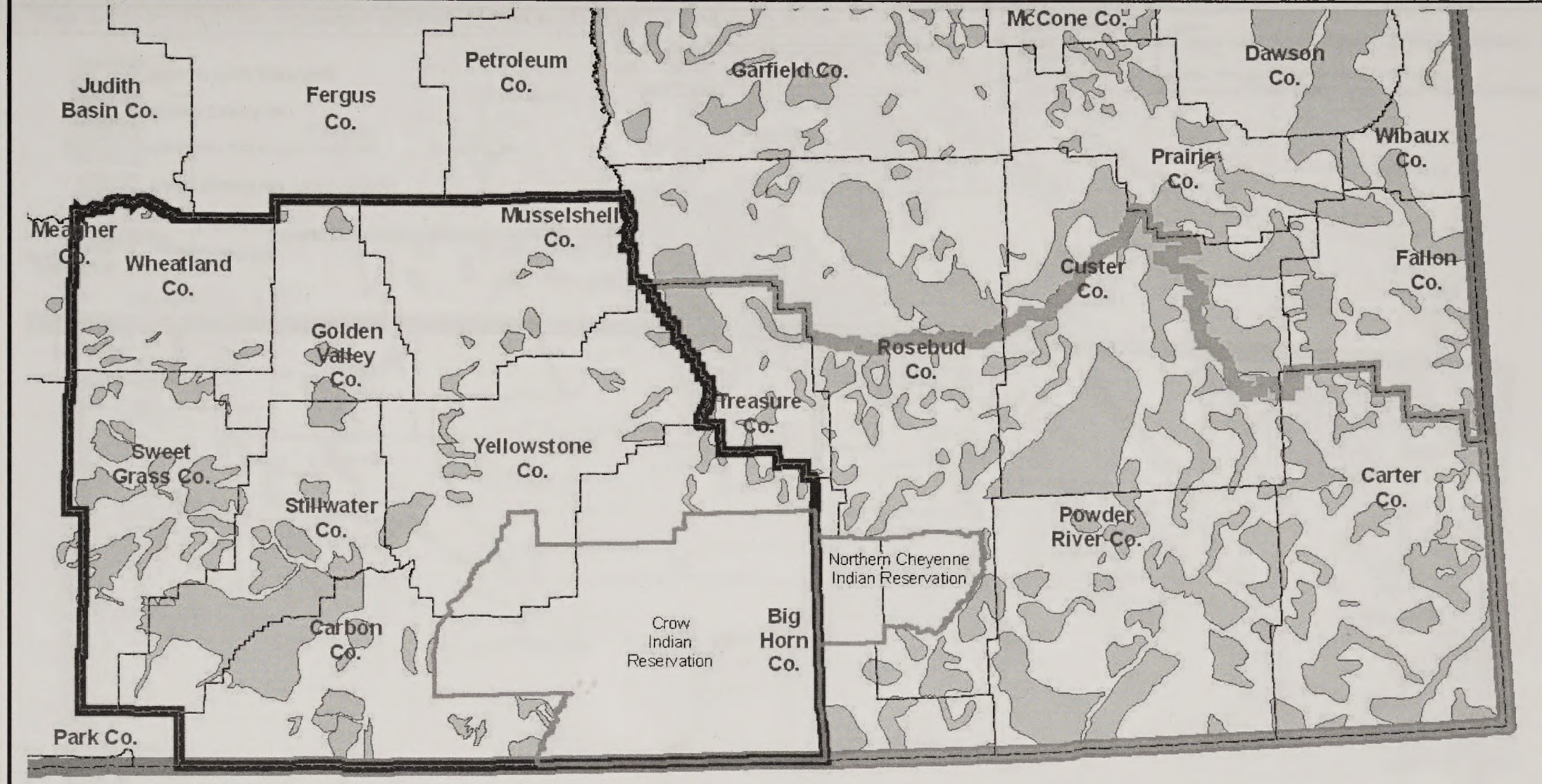
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DATA SOURCES:
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Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Elk Winter Range: 1:100,000 scale, Bureau of Land Management, Billings/Miles City Field Offices

Map 3-13: Mule Deer Winter Range in the CBNG Planning Area



Legend

- Mule Deer Winter Range
- American Indian Reservations
- Billings RMP Area
- Powder River RMP Area

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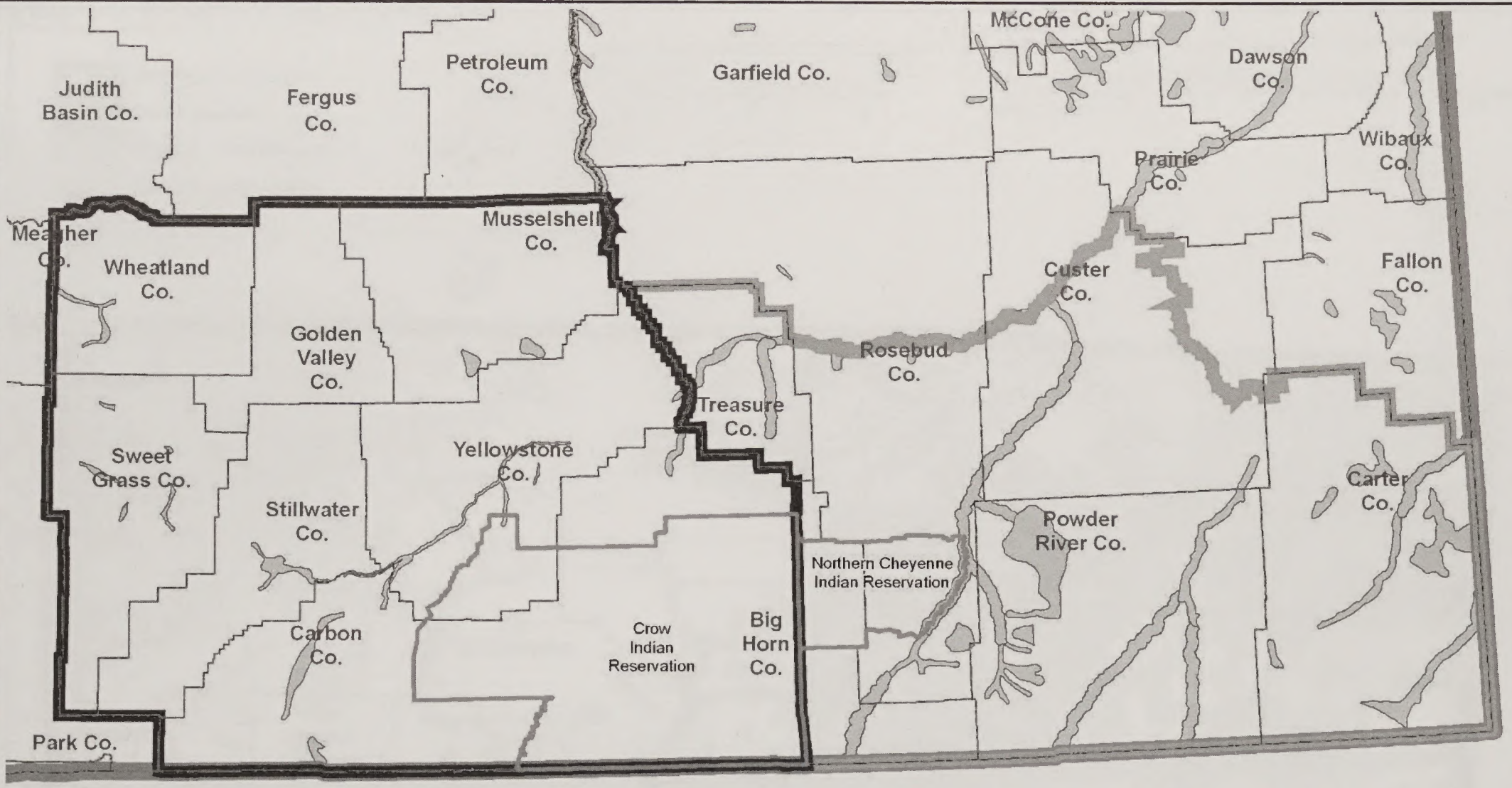
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DATA SOURCES:
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Mule Deer Winter Range: 1:100,000 scale, Bureau of Land Management, Billings/Miles City Field Offices

Map 3-14: White-Tailed Deer Winter Range in the CBNG Planning Area



Legend

- White-Tailed Deer Winter Range
- American Indian Reservations
- Billings RMP Area
- Powder River RMP Area

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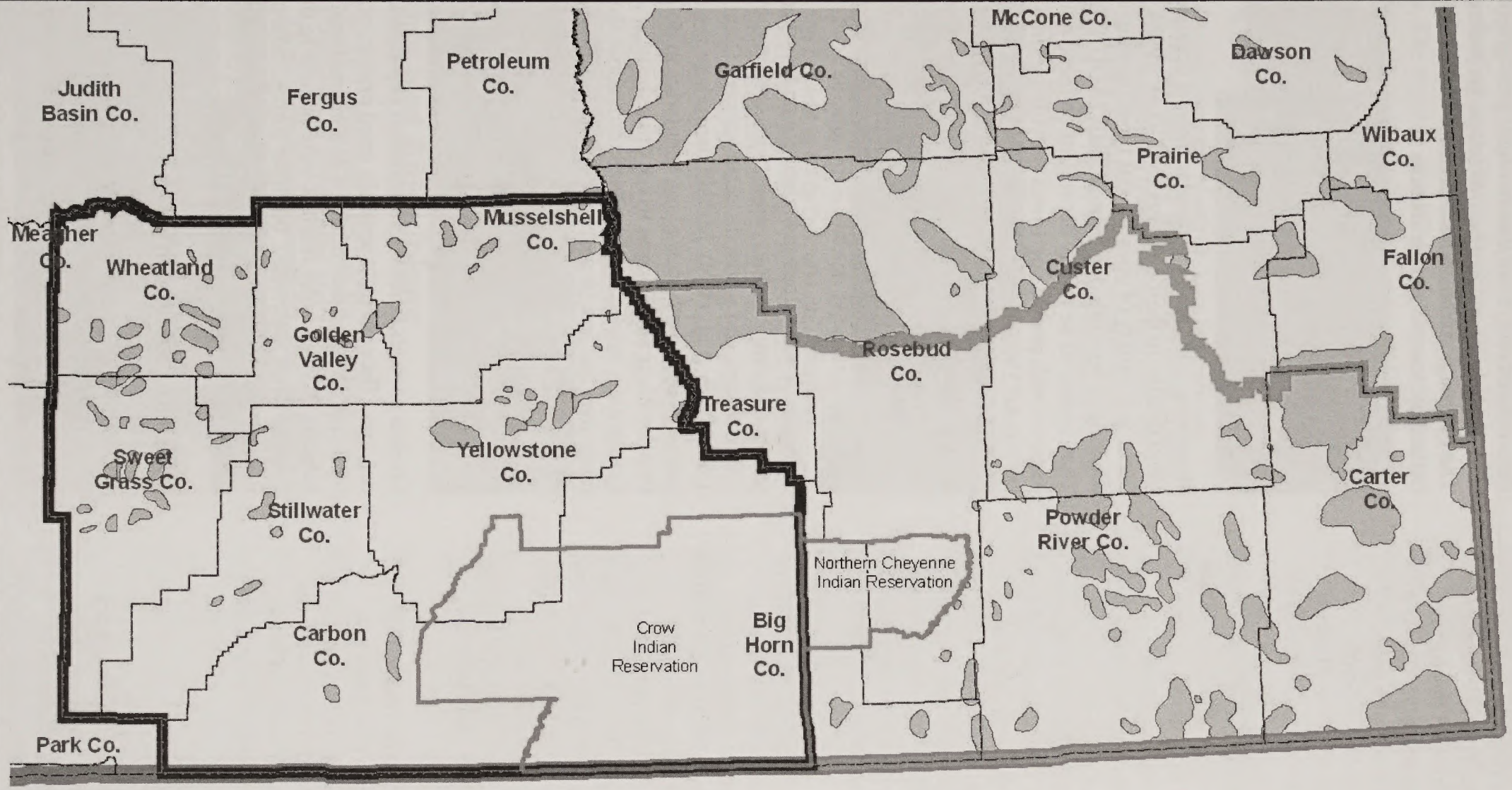
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DATA SOURCES:
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
White-Tailed Deer Winter Range: 1:100,000 scale, Bureau of Land Management, Billings/Miles City Field Offices

Map 3-15: Pronghorn Antelope Winter Range in the CBNG Planning Area



Legend

- Pronghorn Antelope Winter Range
- American Indian Reservations
- Billings RMP Area
- Powder River RMP Area

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1:2,250,000

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DATA SOURCES:
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Pronghorn Antelope Winter Range: 1:100,000 scale, Bureau of Land Management, Billings/Miles City Field Offices

Waterfowl

The Planning Area is within the Central Flyway, which has important migration corridors. Lands in the Planning Area also fall within the Prairie Pothole Joint Venture Management Zone established through the North American Waterfowl Management Plan. The Prairie Pothole Joint Venture is thought to contain the most important duck-breeding habitat in North America. Many spring runoff ponds in the Planning Area provide important habitat for nesting waterfowl. The major rivers and stock ponds provide important habitat for resident ducks and geese, as well as resting areas for migrants. A large variety of ducks, geese and shorebirds use riparian-wetland habitats within the Planning Area for both nesting and migration stopovers. Common species include the mallard (*Anas platyrhynchos*), pintail (*A. acuta*), gadwall (*A. strepera*), blue-winged teal (*A. discors*), common merganser (*Mergus merganser*), Canada goose (*Branta canadensis*), killdeer (*Charadrius vociferus*) and American avocet (*Recurvirostra americana*). The Yellowstone and Clarks Fork drainages are used heavily for nesting by Canada geese and some species of ducks. Nesting occurs mostly on established islands and brushy riparian-wetland areas, providing protection from predators.

Hansen (2001) identified several specific areas that are important to waterfowl and shorebirds. One critical habitat (for waterfowl and shorebird nesting and migration) is the Lake Mason National Wildlife Refuge (NWR), its entire watershed and some associated shallow lakes located in Musselshell County. Another is the Spidel Waterfowl Production Area, USFWS area for waterfowl and shorebirds located at the edge of one of the coal areas about 3 miles northeast of Broadview. A group of major waterfowl and shorebird areas located in Stillwater County between Molt and Rapelje includes Big Lake, Halfbreed NWR and Hailstone NWR.

The Yellowstone River through Yellowstone, Big Horn, Treasure, Rosebud and Custer counties is a major habitat for nesting, migrating and wintering waterfowl. Also, the Howrey Island ACEC is a large island in the Yellowstone River in Treasure County that provides valuable habitat for waterfowl and many other species.

Raptors

Many of the raptors occurring in the Planning Area have been identified by the state of Montana, the USFS, or BLM as sensitive species or species of special interest or concern (Flath 1991; Houtcooper et al. 1985). Those listed by the state include the ferruginous hawk (*Buteo regalis*), osprey (*Pandion haliaetus*), Cooper's hawk (*Accipiter cooperii*), northern goshawk (*Accipiter gentilis*), golden eagle (*Aquila chrysaetos*), merlin (*Falco columbarius*), prairie falcon (*Falco mexicanus*), burrowing owl, flammulated owl (*Otus flammeolus*), great gray owl (*Strix nebulosa*) and Boreal owl (*Aegolius funereus*). The bald eagle (*Haliaeetus leucocephalus*) is discussed in the *Species of Concern* section.

Raptor surveys conducted from 2002 to 2005 in proposed CBNG drilling and pipeline development areas in Big Horn and Powder River counties, red-tailed hawk nests were the most frequently detected raptor nest (see the Wildlife Surveys and Monitoring Since the Statewide Document section).

Burrowing owls are of particular interest because of the rapid decline in their numbers (MT-GAP 1998). They occur in a variety of open habitat types, nesting and roosting in burrows dug by mammals (AOU 1983). They appear to be totally dependent on these mammal burrows with prairie dog towns providing prime habitat (MT-GAP 1998). Raptor surveys conducted from 2002 to 2005 in proposed CBNG drilling and pipeline development areas in Big Horn and Powder River counties, active burrowing owl nesting areas were detected in three of seven surveys (see the Wildlife Surveys and Monitoring Since the Statewide Document section).

Ferruginous hawks occupy relatively undisturbed prairie and shrub steppe regions with scattered trees, rock outcrops and wooded stream bottoms (Evans 1982; Clark et al. 1989). MFWP notes there are a few pairs that apparently nest along tributaries in both the Powder River and Tongue River watersheds. Ferruginous hawks have declined throughout their range over the last 30 years. In seven raptor surveys conducted from 2002 to 2005 in proposed CBNG drilling and pipeline development areas in Big Horn and Powder River counties, one active ferruginous hawk nest was detected (see the Wildlife Surveys and Monitoring Since the Statewide Document section).

Merlins have also suffered substantial population declines. They occur in sparsely treed prairie, prairie parkland, along stream bottoms and in grassland habitats. MFWP notes merlins were present in the Powder River watershed, but little current information is available. No merlin nest sites were detected in the seven raptor surveys mentioned above.

Upland Game Birds

The following section from the Billings and Powder River RMPs describes habitat preferences and important natural history information for the prairie sharp-tailed grouse *(Tympanuchus phasianellus jamesi)* and sage-grouse (*Centrocercus urophasianus*) that applies to the entire Planning Area. Sharp-tails are widely distributed and are generally found in the

grassland, shrub-grassland and woodland vegetation areas. Sharp-tail habitat includes hills, benchlands and other areas of rolling topography that have good stands of residual cover composed chiefly of grasses for roosting, feeding and nesting. Dancing grounds, or leks, are usually flat areas on elevated knolls or benches. The dancing or mating sites are nearly bare of vegetation, although brushy cover is located nearby for feeding and escape. The breeding and nesting period from March to June is the most critical period in the life cycle. Females nest and raise their broods in the grassy uplands, with most nests located within 4 miles of mating grounds.

Studies in southwestern North Dakota have shown more than 90 percent of the nest sites occurred in areas with residual vegetation over 6 inches high and 70 percent of brood locations were in vegetation over 9 inches high (Kohn 1976). Habitat preferences in this Planning Area are similar.

Sage-grouse are discussed under *Species of Concern* later in this Wildlife section.

Neotropical Migrants

A wide variety of neotropical migrants pass through or breed in the Planning Area. Habitat types expected to support the highest species richness and breeding densities include cottonwood and green ash riparian communities (Hopkins 1984) and emergent wetland communities. Several species of birds declining in numbers, including Baird's sparrow (*Ammodramus bairdii*), Sprague's pipit (*Anthus spragueii*), chestnut-collared longspur (*Calcarius lapponicus*) and McCown's longspur (*Calcarius mccownii*) are found in the Planning Area. A number of other bird species, including the Brewer's sparrow (*Spizella breweri*) and loggerhead shrike (*Lanius ludovicianus*), are also declining throughout their range (Hansen 2001) and found within the Planning Area.

Reptiles and Amphibians

The MT-GAP (1998) indicates that the Planning Area supports 9 species of amphibians and 14 species of reptiles. These include one salamander, four frogs, four toads, three turtles, two lizards and nine snakes. MFWP has expressed particular concern about nine of these species, including the northern leopard frog (*Rana pipiens*), boreal/western toad (*Bufo boreas*), Great Plains toad (*Bufo cognatus*), Plains spadefoot (*Spea bombifrons*), western hog-nose snake (*Heterdon nasicus*), milk snake (*Lampropeltis triangulum*), greater short-horned lizard (*Phrynosoma hernandesi*), snapping turtle (*Chelydra serpentine*) and spiny softshell turtle (*Trionyx spiniferus*).

Leopard frogs have declined substantially in western and to a somewhat lesser extent, central Montana (MT-GAP 1998). They are locally abundant in southeastern Montana (Reichel and Flath 1995). They are associated with permanent slow moving water bodies with considerable vegetation, but may also range into moist meadows and grassy woodlands and occasionally agricultural areas (Nussbaum et al. 1983). They are most often associated with riparian habitats and near permanent water. Tiger salamanders occur throughout the Planning Area wherever there is terrestrial substrate suitable for burrowing and a nearby body of water for breeding (MT-GAP 1998). All amphibians are particularly susceptible to effects from water quality degradation because larval stages are spent in water and they absorb water through their skin during all life stages.

The western hognose snake occurs in a variety of habitats throughout central and eastern Montana. They are especially associated with arid areas, prairie grasslands and shrublands and floodplains with gravely or sandy soils (Reichel and Flath 1995). Milk snakes occur in suitable habitats throughout south central and southeastern Montana. Preferred habitats include sandstone bluffs, rock outcrops, grasslands and open ponderosa pine and juniper stands (Hendricks and Reichel 1996). The spiny softshell is a riverine species that occurs primarily in the larger rivers of southeastern Montana. It is found in well-oxygenated, slower moving water with nearby mud flats and sandbars and occasionally in back water sloughs (MT-GAP 1998).

Species of Concern

This section discusses wildlife species of concern that occur in the Planning Area. These include species listed or proposed for protection under the ESA, species classified as sensitive by the BLM or Forest Service and species considered to be critically imperiled in the State of Montana. Table 3-39 and the following discussion present information about the species protected under ESA.

Birds

Bald Eagle

This species was removed from the list of threatened and endangered species in 2007. Bald eagles concentrate in and around areas of open water where waterfowl and fish are available. They prefer solitude, late-successional forests, shorelines adjacent to open water, a large prey base for successful brood rearing and large, mature trees for nesting and roosting.

Bald eagle recovery zones include the Powder and Missouri rivers. Bald eagles nest along the Yellowstone River in Rosebud and Custer counties and the Tongue River in Custer and Powder River counties. The Yellowstone River is used during spring and fall

TABLE 3-39

ENDANGERED, THREATENED AND PROPOSED ANIMAL SPECIES PRESENT IN THE SEIS PLANNING AREA

Common Name	Scientific Name	Habitat in Montana	Federal Status*
Birds			
interior least tern	*Sterna antillarum athalassos*	Sandbars and beaches in eastern Montana and along the Yellowstone and Missouri rivers	E
Mammals			
gray wolf	*Canis lupus*	Adapted to many habitats, need large ungulate prey base and freedom from human influence	E/10(j)
Canada lynx	*Felis lynx canadensis*	Montana spruce/fir forest in western Montana	T
black-footed ferret	*Mustela nigripes*	Prairie dog complexes in eastern Montana	E
grizzly bear	*Ursus arctos horribilis*	Alpine/subalpine coniferous forest in western Montana	T

*T = Threatened; E = Endangered; C = Candidate; PT = Proposed Threatened;
E/10(j) = Endangered/Experimental Nonessential Populations.

migration. Peak occurrence is November through April. The Missouri, Yellowstone, Musselshell, Tongue and Powder rivers provide habitat during migration as well as during the winter months. Bald eagles currently are expanding their nesting territories down the Yellowstone River (Flath 1991).

Bald eagle winter roost and nest surveys have been conducted in association with the POD areas (Dry Creek, Pond Creek, Deer Creek North, Coal Creek and Badger Hills). These surveys are conducted for the area covered by the POD as well as a 2-mile buffer. Additionally, winter roost and nest surveys have been conducted along the Tongue River corridor from the Wyoming state line to below the Tongue River Reservoir along the Tongue River corridor. Surveys are ongoing and have been conducted by Fidelity Exploration, Quaneco, Powder River Gas and BLM.

Three bald eagle winter habitat/roost surveys were completed within the Upper Tongue River in 2004. The survey route started at Birney, Montana, to approximately 5 miles south of the Montana/Wyoming border at the intersection of the Tongue River and Wyoming Highway 338. Survey results were as follows:

- January 14th —15 bald eagles (9 mature and 6 immature) were observed at 11 locations.
- February 2nd—17 bald eagles (9 mature and 8 immature) were observed at 9 locations.
- March 4th—50 bald eagles (24 mature/26 immature) were observed at 22 locations.

The increase in numbers of bald eagles in the March flight was due, in part, to this portion of the river containing relatively little ice cover. The Wildlife Surveys and Monitoring since the Statewide Document section provides additional information on recent bald eagle surveys.

Interior Least Tern

The historic distribution of the interior least tern is the major river systems of the plains states and midwestern U.S. The occurrence of breeding least terns is localized and is highly dependent on the presence of dry, exposed sandbars and favorable river flows that support a forage fish supply and isolate the sandbars from the riverbanks. Characteristic riverine nesting sites are dry, flat, sparsely vegetated sand and gravel bars within a wide, unobstructed, water-filled river channel. In the upper Missouri River Basin, it often nests with piping plovers. During spring and fall migrations, the least tern uses stockwater reservoirs (Flath 1991).

The least tern is known to nest in the Planning Area. Its habitat includes graveled islands in the lower Yellowstone River.

Peregrine Falcon

The peregrine falcon was delisted on August 25, 1999 and protection from take and commerce for the peregrine falcon is no longer provided under the ESA. However, peregrine falcons are still protected by the Migratory Bird Treaty Act (MBTA). The MBTA and its implementing regulations (50 CFR parts 20 and 21) prohibit take, possession, import, export, transport,

selling, purchase, barter, or offering for sale, purchase, or barter any migratory bird, their eggs, parts and nests, except as authorized under a valid permit (50 CFR 21.11). With limited exceptions, take will not be permitted under MBTA until a management plan is developed in cooperation with state wildlife agencies, undergoes public review, is approved, finalized and published in the FR.

Peregrine falcons migrate through the Planning Area during spring and fall, especially along rivers and other water bodies that support waterfowl and shorebirds. Peregrines are believed to nest northeast of Great Falls, possibly within the Planning Area.

Mammals

Gray Wolf

This species was listed as endangered on March 11, 1967. On November 18, 1994, the USFWS announced experimental populations of this species would be reintroduced in central Idaho and southwestern Montana. Populations classified as experimental are exempt from full endangered status. Historically, the gray wolf ranged throughout Montana. It appears to have been common throughout the state, inhabiting both short and tall grass prairie as well as forested regions. It has no particular habitat preference, but requires areas with low human population, low road density and high prey density, which are ideally large, wild ungulates.

Most confirmed wolf sightings and pack accounts are for western Montana, along the Bitterroot divide and in the areas around Yellowstone National Park, where it has been reintroduced (Fisher et al. 1998).

The most recent Rocky Mountain Wolf Recovery Annual Report estimates the experimental wolf population in southern Montana to be 73 wolves (MFWP, 2008). The range of the Moccasin Lake, Phantom Lake, Red Lodge and Beartooth wolf packs occurs within, or partially within, the Planning Area (USFWS et al. 2005).

Canada Lynx

This species was listed as threatened on March 24, 2000. It is dependent on snowshoe hares and found in the same habitats, which include dense, mature old-growth lodgepole pine, Douglas fir, Engelmann spruce and subalpine fir forest. Distribution and primary potential habitats for Montana are in the western portion of the State in mature coniferous forests with a well-developed understory. Dens are primarily located in mature lodgepole pine and spruce-fir forests.

Black-footed Ferret

Black-footed ferrets depend almost exclusively on prairie dogs for food and shelter. They primarily prey on prairie dogs and use their burrows for shelter and dens. Ferret range is coincident with that of prairie dogs. There is no documentation of black-footed ferrets breeding outside of prairie dog colonies. There are specimen records of black-footed ferrets from ranges of three species of prairie dogs: the black-tailed prairie dog (*Cynomys ludovicianus*), white-tailed prairie dog (*Cynomys leucurus*) and Gunnison's prairie dog (*Cynomys gunnisoni*).

Several releases of black-footed ferrets have taken place over the years on public land and the Fort Belknap Indian Reservation north of the Planning Area in Phillips County, Montana. Black-footed ferrets have been released on the Northern Cheyenne Reservation in January of 2008 and additional ferrets will be released the summer of 2008. This population is considered endangered (Hanebury 2008). In Montana, the goal is to reestablish two viable populations with a minimum of 50 breeding adults in each.

Grizzly Bear

This species was listed as threatened on March 11, 1967. On November 11, 2000, the USFWS listed some populations in Montana and Idaho as experimental in order to facilitate restoration to designated recovery areas. The grizzly bear was once found in a wide variety of habitats including open prairie, brushlands, riparian woodlands and semidesert scrub. Its distribution in Montana is now limited to the Northern Continental Divide Ecosystem and the Yellowstone Ecosystem with a few in the Cabinet-Yaak Ecosystem. Scattered individuals may occur in the mountainous areas of western Montana. It no longer exists in the wild in eastern Montana. Most populations require vast areas of suitable habitat to prosper. This species is common only in habitats where food is abundant and concentrated, including white-bark pine, berries and salmon or cutthroat runs and where conflicts with humans are minimal.

State Species of Special Concern

In addition to species that are federally protected under the ESA, the State of Montana has designated additional species of concern within its jurisdictional boundaries. There are five rankings for State Species of Special Concern. This document focuses only on the highest ranking (S1). This ranking is defined as critically imperiled because of extreme rarity (five or fewer occurrences, or very few remaining individuals),

or because some factor of its biology makes it especially vulnerable to extinction.

State-listed species (with BLM and USFS rankings) that have potential distributions within the 13-county Planning Area of this SEIS or have undefined distributions in the state are listed in the Wildlife Appendix, *Wildlife Species of Concern* (see Table WIL-1 for Special Status Species of State of Montana, BLM and USFS). Species that are federally listed under the ESA have been omitted from these tables because they have been considered. Table WIL-1 also lists vertebrate species of concern for the state, BLM, or the USFS.

The Statewide Document included three other species proposed for listing or considered possible candidates for listing under ESA. These species include sage-grouse, mountain plover and black-tailed prairie dog and are discussed below.

Birds

Sage-grouse

Previously considered a possible candidate for listing under ESA, USFWS determined the sage-grouse is not warranted for listing, because the species is not likely to become endangered or threatened in the foreseeable future (USFWS 2005b). However, a recent ruling in Idaho (December 2007) remanded the decision not to list the sage grouse back to the USFWS for reconsideration. This species is a BLM and a Forest Service sensitive species.

Sage-grouse Distribution, Habitat Needs and Population Dynamics

Sage-grouse are native to the sagebrush steppe of western North America and their distribution closely follows that of sagebrush, primarily big sagebrush (Montana Sage-grouse Work Group 2005). The importance of mature sagebrush with a good understory of grasses and forbs is well documented. In eastern Montana, where close interspersion of wintering, nesting, breeding and brood-rearing habitat rarely require large seasonal movements, sage-grouse are essentially nonmigratory. Seasonal habitat components for sage-grouse are described in Table 3-40 and habitat distribution and use within the Planning Area are depicted in Map 3-16.

Sage-grouse densities for Wyoming and Montana are shown on Map 3-17. Densities were derived from male lek attendance and are meant to illustrate the importance of the PRB to sage-grouse (Draft Greater Sage Grouse Comprehensive Conservation Strategy). The map illustrates the importance of the PRB for connectivity for sage-grouse.

Sage-grouse males appear to form strutting grounds (leks) opportunistically at sites within or next to potential nesting habitat. Although the lek may be an approximate center of annual ranges for non-migratory populations (Eng and Schladweiler 1972, Wallestad and Pyrah 1974, Wallestad and Schladweiler 1975), this may not be the case for migratory populations (Connelly et al. 1988, Wakkinen et al. 1992). Average distances between nests and nearest leks vary from 0.66 to 3.75 miles, but the documented distances from leks with which females were associated to their nests have exceeded 12 miles (Autenrieth 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000). Nests are placed independent of lek location (Bradbury et al. 1989, Wakkinen et al. 1992). Nesting habitat is usually located under sagebrush with about 50 percent of the nests within 2 miles of leks (Wallestad and Pyrah 1974, Martin 1970).

Since the 1950s, counts of sage-grouse males on leks have been used to provide an index of relative size and trends of breeding populations of sage-grouse in Montana (Montana Sage-grouse Work Group 2005). Statewide, sage-grouse numbers increased from the mid-1960s through 1973 and fluctuated at about the same level until 1984. Sage-grouse declined rather sharply statewide from 1991 through 1996 and increased through 2000.

Results illustrated in Table 3-41 bear out the general trend of sage-grouse in the Planning Area. Results indicate average male high counts from 2002 to 2004 were lower than those from 1999 to 2001 (Table 3-41).

TABLE 3-40
CHARACTERISTICS OF SAGE-GROUSE SEASONAL HABITATS

Seasonal Habitat	Characteristics
Breeding	Strutting grounds (leks) where breeding actually occurs are key activity areas and most often consist of clearings surrounded by sagebrush cover.
Nesting	Sagebrush (with a combination of shrub [sage-grouse most frequently select nesting cover with a sagebrush canopy of 15 to 31 percent] and residual grass cover) provides for concealment of nests.
Brood-rearing	Relatively open (generally canopy cover from 1 to 25 percent) stands of sagebrush contain an abundance and diversity of succulent forbs. In late summer, sage-grouse often move to moist areas still supporting succulent vegetation, including alfalfa fields, roadside ditches and other moist sites.
Winter	Relatively tall and large expanses of dense sagebrush are present. The importance of shrub height increases with snow depth; thus, snow depth can limit the availability of wintering sites for sage-grouse.

Source: Montana Sage-grouse Work Group 2005.

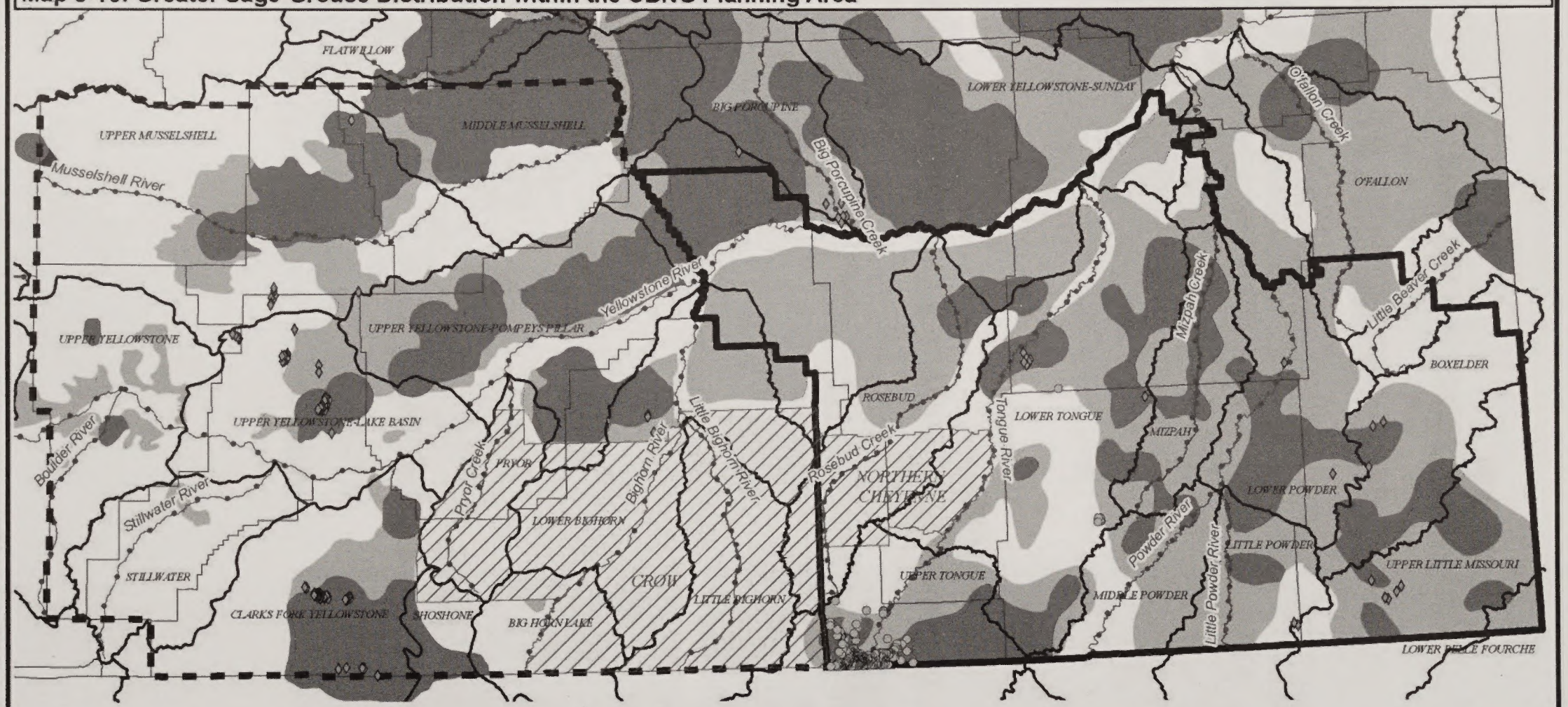
TABLE 3-41
SAGE-GROUSE ACTIVE LEK AVERAGE MALE HIGH COUNTS IN THE PLANNING AREA, 1995 TO 2004

Year	Number of Active Leks Surveyed	Average Male High Count for Active Leks[1]
1995	4	10.3
1996	9	12.1
1997	4	21.0
1998	4	20.0
1999	39	21.4
2000	73	25.2
2001	67	22.2
2002	52	14.0
2003	73	10.3
2004	42	14.0

Source: Montana Department of Fish, Wildlife and Parks (2004).

[1] Values are based on those active leks where at least one male was observed during a given year.

Map 3-16: Greater Sage-Grouse Distribution within the CBNG Planning Area



Legend

- Billings RMP Area
- Powder River RMP Area
- Native American Reservation
- Major River
- 4th Code Watershed Boundary

Producing Well

- Coal Bed Natural Gas
- Gas

Sage-Grouse Distribution

- Overall Distribution/Year Round Use
- Nesting/Early Brood Rearing and Overall Distribution/Year Round Use
- Not Known if Consistently/Regularly Used

Note: Sage-Grouse distribution was not mapped within Native American Indian Reservations.

N, W, E, S

30 15 0 30 Miles

50,000 0 50,000 Meters

DATA SOURCES:

Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Rivers: 1:100,000 scale, rivers, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana.
RMP Areas: BLM Miles City Field Office
Well Locations: 9/1/2005 Download, Montana Board of Oil & Gas Conservation.
4th Code Watersheds: 1:250,000 scale, hydrologic unit codes, 1994, U.S. Geological Survey, Reston, Virginia.
Sage-Grouse Distribution: 1:100,000 scale, sage-grouse habitat/current distribution, 8/10/2001, Montana Fish, Wildlife and Parks.

Prepared by Parametrix Inc., 29 March, 2006, K:\gis\all_5055\oil_gas_seis\mapdocs\eis_fig-sage-wells-032906.mxd

Sage-grouse Diet

Sagebrush provides 80 to 100 percent of sage-grouses' winter diet (Wallestad and Schladweiler 1975, Martin 1970, Eng and Schladweiler 1972). Forbs, especially dandelion and salsify and insects are an important dietary component for the juveniles and adults in the spring and summer and wet meadows and other riparian areas are heavily used in the summer as sagebrush areas dry out.

West Nile Virus

West Nile virus (WNV) is a disease transmitted to birds and other animals by the mosquito (*Culex tarsalis*). Mosquitoes can potentially breed in any standing water that lasts more than four days. However, *Culex tarsalis* depends at least somewhat on water bodies with emergent vegetation (BLM 2005b).

Since publication of the Statewide Document, research has indicated that WNV is affecting sage-grouse (Naugle et al. 2004, Walker et al. 2004). A report published by Naugle and others in 2004 indicated WNV reduced late summer 2003 female sage-grouse survival an average of 25 percent in four radio-marked populations in Montana, Wyoming and Canada (Naugle et al. 2004). In the following spring (2004), the researchers discovered breeding sage-grouse populations declined precipitously in an area of northeastern Wyoming with concentrated WNV mortalities the previous summer, whereas unaffected areas showed increased populations (Walker et al. 2004).

Despite regular spring and summer precipitation, researchers confirmed only two WNV mortalities in 2005. The low rates of WNV-related mortality and the low seroprevalence (less than 10 percent) suggests that WNV impacts may be limited by low rates of exposure to the virus rather than to high levels of resistance (B. Walker, e-mail communication, December 1, 2005).

Another study, (Zou, et. al, 2006) shows a 75 percent increase in larval habitats for mosquitoes from 1999 to 2004 as a result of coal bed natural gas water discharge ponds. In addition, 70 percent of all human cases of WNV in 2003 in Wyoming were from the PRB. In a similar, but unrelated, study near Roundup, Montana, researcher Jay Rotella at Montana State University documented that in 2005 three sage-grouse mortalities tested positive for the WNV (J. Sika, e-mail communication, September 16, 2005).

Montana Management Plan and Conservation Strategies for Sage-grouse

The Montana Sage-grouse Work Group, a cooperative membership of state, federal, tribal and private entities, recently prepared a conservation and management plan for sage-grouse in Montana (Montana Sage-grouse Work Group 2005). The plan establishes a process to achieve sage-grouse management objectives and provides a framework to guide local management efforts and coordinated management across jurisdictional boundaries. The overall goal of the plan is to "provide for the long-term conservation and enhancement of the sagebrush steppe/mixed-grass prairie complex within Montana in a manner that supports sage-grouse and a healthy diversity and abundance of wildlife species and human uses. Objectives include maintaining the distribution of sage-grouse populations within the mountain foothills mixed sagebrush and Wyoming big sagebrush-silver sagebrush ecotypes based on a consistently applied monitoring protocol" (p. *ii* of the Plan).

BLM is an active participant in the Montana Sage-grouse Work Group. The agency continues to collaborate with the work group and implement actions to conserve sage-grouse and other sagebrush-associated species. BLM is also an active participant in the southeastern Montana Local Working Group developing plan implementation strategies. BLM has provided funding for a statewide interagency sage-grouse coordinator.

Ongoing Sage-grouse Habitat and Oil and Gas Research

Naugle et.al. (2004) from the University of Montana and Gail Patricelli (2005) from the University of California-Davis are currently conducting studies on the effects of oil and gas development on sage-grouse, including nest success and brood survival. Patricelli's study focuses on the effects of noise from oil and gas development on sage-grouse. Naugle is investigating sage-grouse habitat use and developing sage-grouse habitat models to prioritize landscapes for sage-grouse conservation.

In 2006, Naugle, used satellite imagery to identify priority habitats for sage-grouse in the PRB. This information coupled with digital elevation models and ground verified, identified areas of high value sage-grouse habitat. This mapping used several components, including roughness, sagebrush coverage (height/abundance) and distance from conifers. Much of the recent research conducted by Naugle, et al.

focused on the impact of CBNG development on male sage-grouse attendance on strutting grounds.

Research conducted by Holloran in southwest Wyoming focused mainly on natural gas development in the Jonah Field and the Pinedale Anticline. The research clearly indicated male sage-grouse avoid strutting grounds close to active development. Avoidance was observed to a distance of approximately 6.2 kilometers from active development. Male sage-grouse avoided leks within 2 kilometers of development. Leks within areas of development showed a drop in the number of males, while leks on the edge of development showed increases in male attendance. This increase is possibly due to male displaced from leks within areas of development.

Sage-grouse hens near active development moved twice as far in search of undisturbed nesting habitat as did hens in areas with no development. Holloran also found nest success was lower, the closer hens nested to development.

BLM identified four crucial sage-grouse habitat areas within the study area (see Map 3-18), two of which extend into Wyoming. These areas are considered to be of crucial importance to maintaining viable populations of sage-grouse within the Montana portion of the PRB. The goal was to identify nonfragmented, core habitats in which existing sage-grouse populations could be maintained.

Maintaining core populations is important to conserve sage-grouse throughout this area. Genetic diversity is necessary for the sage-grouse to adapt to changes within its environment. Loss of genetic diversity will limit a population's ability to overcome stressors such as habitat change, disease and climate. Maintaining the ability of the sage-grouse to disperse (corridors) is the most efficient way to ensure genetic diversity. In addition, these small populations may be an important source of birds needed to repopulate those portions of the PRB, once energy development has been competed (personal communication, David Naugle).

Holloran and Anderson from the University of Wyoming, recently conducted studies on the effects of natural gas development on sage-grouse. This recent research (Holloran and Anderson 2004, Holloran 2005) and ongoing studies specific to CBNG development in the Powder River Basin indicate local populations of sage-grouse will decline unless areas are maintained to provide suitable habitat for all critical life cycle periods (i.e., brood rearing, breeding and wintering).

Mountain Plover

When the Statewide Document was completed, the mountain plover had been proposed for listing as threatened. USFWS withdrew the proposed listing because new information indicated threats to the species included in the proposed listing were lower than earlier believed (USFWS 2003). This species is a BLM sensitive species.

The mountain plover was once widely distributed across short-grass prairies on the western Great Plains, occupying a range extending from Montana to New Mexico and Texas. Conversion of native prairies to agriculture has significantly reduced suitable breeding habitats for this species. It prefers relatively flat sites of short grass. Intensive grazing may be beneficial for mountain plovers and they also regularly occupy prairie dog towns. High arid plains and shortgrass prairie with blue grama-buffalo grass communities are the primary habitat. The mountain plover does not winter in Montana, but may breed within the Planning Area, particularly on black-tailed prairie dog towns. A breeding population is known to exist north of Ingomar, Montana, as well as central, north-central and southwest Montana and is considered transitory in other parts of the state, such as the Greater Yellowstone ecosystem. Blaine and Phillips Counties currently support the bulk of mountain plovers that nest in Montana. No mountain plovers were detected in surveys conducted from 2002 to 2005 in areas of proposed CBNG development in Big Horn, Powder River and Rosebud counties (see the Wildlife Surveys and Monitoring Since the Statewide Document section).

BUREAU OF LAND MANAGEMENT
MONTANA/DAKOTAS AND WYOMING
GREATER SAGE-GROUSE STRUTTING
MALE DENSITIES
Map 3-17

MONTANA

NORTH DAKOTA

SOUTH DAKOTA

WYOMING

Legend

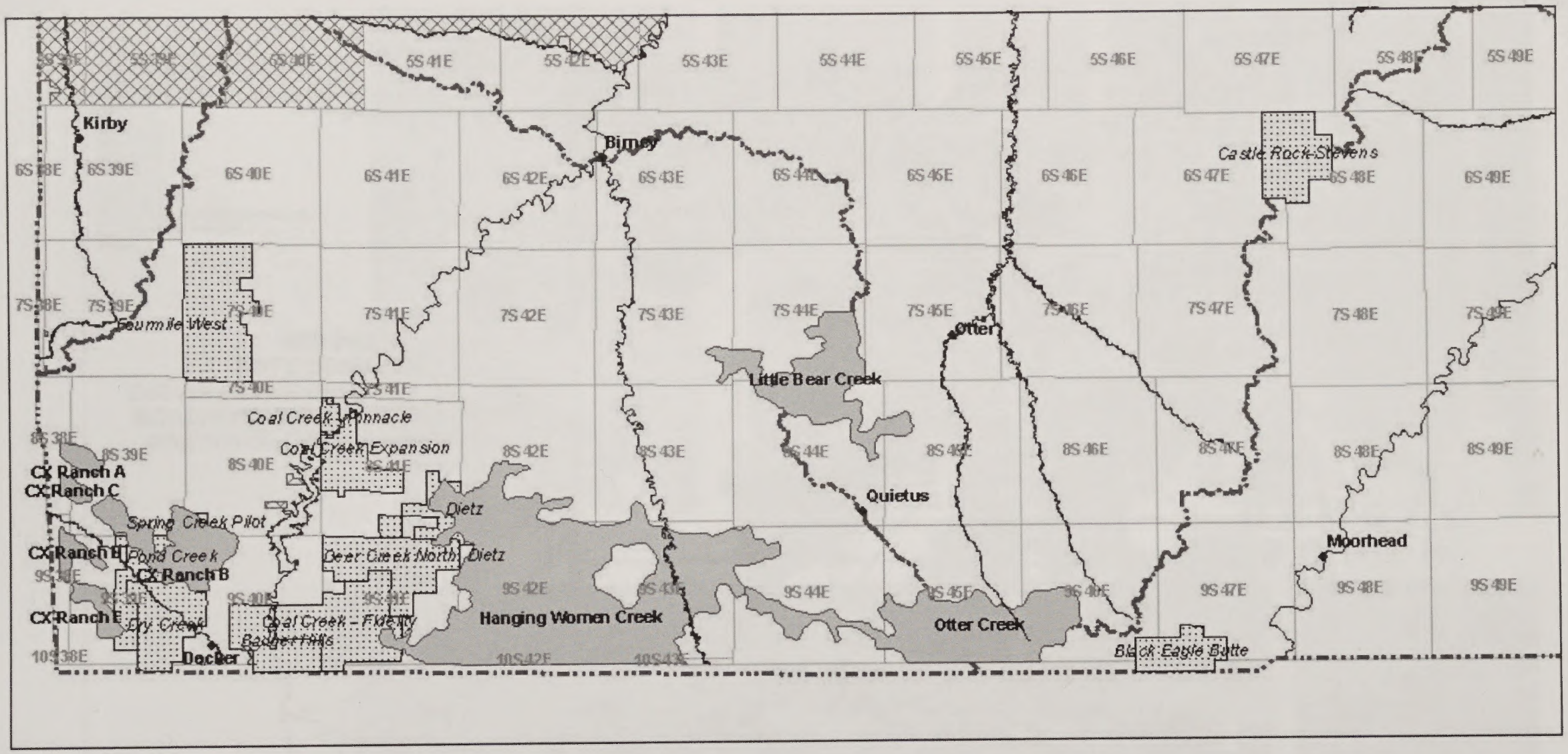
Sage-Grouse Management Zones

Sage-Grouse Males at Leks per Square Kilometer of Habitat*

- 0 - 0.05
- 0.05 - 0.10
- 0.10 - 0.15
- 0.15 - 0.20
- 0.20 - 0.25
- 0.25 - 0.30
- 0.30 - 0.35
- 0.35 - 0.40
- > 0.40

*Male sage-grouse lek attendance data taken from the Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats (Western Association of Fish and Wildlife Agencies)

0 15 30 60 90 120 Miles



Legend

- CBNG PODs
- Watershed Boundaries
- Major Streams
- Coal Mines
- Native American Indian Reservations
- Crucial Sage-Grouse Habitat Areas

Map 3-18
Crucial Sage-Grouse Habitat Areas

0 3 6 12 18 24 Miles

N W E S

Mammals

Black-tailed Prairie Dog

This species was proposed for listing as threatened on March 25, 1999. On February 3, 2000, USFWS determined the black-tailed prairie dog warranted listing under ESA. USFWS did not propose to list the species at that time due to higher priority species awaiting listing. Since that time, USFWS removed the black-tailed prairie dog from the list of candidate species because it is not likely to become endangered or threatened within the foreseeable future (USFWS 2004). The black-tailed prairie dog is a BLM sensitive species.

The current distribution of black-tailed prairie dogs (*Cynomys ludivicianus*) includes suitable short grass prairie within all but the southwestern most portion of the Planning Area (MFWP 2005). Black-tailed prairie dogs were detected in each of six surveys conducted from 2002 to 2005 in areas of proposed CBNG development in Big Horn, Powder River and Rosebud counties (see Wildlife Surveys and Monitoring Since the Statewide Document section). Although the original abundance of prairie dogs in Montana is unknown, early accounts indicate they were abundant and widely distributed east of the Continental Divide in grasslands and sagebrush-grasslands. This species can colonize a variety of shrub-grassland and grassland habitats. Generally, the most frequently used habitats in Montana are dominated by western wheatgrass, blue grama and big sagebrush and are located in relatively level areas in wide valley bottoms, rolling prairies and the tops of broad ridges. Species with close associations to prairie dogs include black-footed ferrets, burrowing owls, mountain plovers and ferruginous hawks. These are all species of concern.

Wildlife Surveys and Monitoring Since the Statewide Document

Since publication of the Statewide Document, numerous wildlife-related surveys and inventories have been conducted, as described below. Due to adjacent overlapping survey areas, some raptor nests have been inventoried or monitored in more than one POD. Therefore, the total number of raptor nests is not additive in the following inventory or monitoring efforts.

1. **Raptor Nests Inventory and Monitoring in the CBNG Area, 2003 to 2005**

   BLM maintains a database of results from multiple raptor nest surveys conducted from 2003 through 2005. Information from this database identifies 67 nest sites surveyed and monitored from 2003 to 2005 in the CBNG area (Table 3-42).

2. **Ongoing Sage-grouse Studies**

   Male sage-grouse attendance on leks has been surveyed annually, primarily since 2001. Essentially all leks within and directly adjacent to areas of development have been surveyed by BLM MFWP, industry, interest groups and researchers. This information has been provided to and is stored by MFWP.

3. **Fidelity Exploration & Production Company, Montana 2002 and 2003 Drilling Area, Baseline Wildlife Inventory**

   Hayden-Wing Associates (2002) conducted baseline wildlife surveys (raptor nests, prairie dog towns and mountain plover) in 2002 on Fidelity Exploration & Production Company's proposed CBNG drilling areas located in Big Horn County, Montana. Forty-four raptor nest sites were located in the area (Table 3-43). Other survey results included the identification of 11 prairie dog colonies. No mountain plovers were observed.

4. **Fidelity Exploration & Production Company, Big Horn County Black-footed Ferret Surveys**

   Hayden-Wing (2003) conducted black-footed ferret surveys in an area proposed for pipeline installation in Big Horn County, Montana. No black-footed ferrets or their sign were observed.

TABLE 3-42
RAPTOR NESTS SURVEYED AND MONITORED IN THE CBNG AREA, 2003-2005

Species	Total Number of Nests	Active Nests
Red-tailed hawk	41	23
Cooper's hawk	1	1
Golden eagle	5	5
Bald eagle	1	1
Prairie falcon	1	0
Osprey	6	5
Great-horned owl	2	2
Barn owl	1	1
Burrowing owl	8	7
Unidentified raptor	1	0

Source: BLM database raptor nests inventory and monitoring in the CBNG area, 2003 to 2005

TABLE 3-43
RAPTOR NESTS LOCATED IN THE FIDELITY'S MONTANA 2002 AND 2003 DRILLING AREA IN BIG HORN COUNTY, MONTANA 2002

Species	Total Number of Nests	Active Nests (during the May surveys)
Red-tailed hawk	24	7
Golden eagle	6	2
Bald eagle	2	2
Prairie falcon	8	1
Osprey	2	2
Great-horned owl	2	2

Source: Hayden-Wing Associates baseline wildlife surveys (2002)

5. Fidelity Exploration & Production Company, Proposed Coal Creek POD, Big Horn County, Baseline Wildlife Inventory

Hayden-Wing Associates (2004a) conducted baseline wildlife surveys (raptor nests, prairie dog towns and mountain plover) during 2003 on Fidelity Exploration & Production Company's Coal Creek POD located in Big Horn County, Montana. Eleven raptor nest sites were located in the area (Table 3-44).

No bald eagle nests were located within the POD area or 1-mile buffer. One active bald eagle nest was located approximately 10.6 miles from the POD. Bald eagle winter surveys were also conducted in January and December 2003. Fifty-three bald eagles were observed during the January 30th survey. Nineteen bald eagles were observed during the December 2nd survey and ten bald eagles were observed during the December 12th survey, although none of these birds were located within the POD or the 1-mile buffer. During the December 19th survey, 14 bald eagles were located, with one inside the 1-mile buffer and the others outside the buffer. Other survey results include identification of one active double-crested cormorant rookery, one active great blue heron rookery and one black-tailed prairie dog colony. No mountain plovers were observed.

6. Fidelity Exploration & Production Company, Proposed Pond Creek POD and Dry Creek POD, Big Horn County, Black-footed Ferret Surveys

Hayden-Wing (2004b) conducted black-footed ferret surveys in areas proposed for road construction and well development (Pond Creek POD and Dry Creek POD) in Big Horn County, Montana. No black-footed ferrets or their sign were observed.

TABLE 3-44

RAPTOR NESTS LOCATED IN THE FIDELITY'S MONTANA PROPOSED COAL CREEK POD, BIG HORN COUNTY, MONTANA 2002

Species	Total Number of Nests	Active Nests (during the May surveys)
Red-tailed hawk	8	1
Bald eagle	1	1
American kestrel	1	1
Great-horned owl	1	1

Source: Hayden-Wing Associates baseline wildlife surveys (2003)

7. Fidelity Exploration & Production Company, Coalbed Natural Gas Development Areas in Big Horn County, Montana, Wildlife Surveys, 2004

Hayden-Wing Associates (2005) conducted baseline and monitoring surveys for wildlife (raptor nests, wintering bald eagles, sage-grouse, sharp-tailed grouse, prairie dog towns, mountain plover and black-footed ferret) during 2004 on Fidelity Exploration & Production Company's proposed CBNG drilling areas located in Big Horn County, Montana. Seventy raptor nest sites were located in the area (Table 3-45).

In addition, one bald eagle nest was located just outside the 1-mile buffer of the Coal Creek and Pond Creek PODs. Forty-three bald eagles were observed during the three winter surveys. Other survey results include the identification and monitoring of 20 sage-grouse leks, 10 of which were active; 26 sharp-tailed grouse leks, four of which were active; and 29 black-tailed prairie dog colonies. No mountain plovers or black-footed ferrets or their signs were observed.

8. Fidelity Exploration & Production Company, Coalbed Natural Gas Development Areas in Big Horn County, Montana, Wildlife Surveys, 2005

Hayden-Wing Associates (2006) conducted baseline and monitoring surveys for wildlife (raptor nests, wintering bald eagles, sage-grouse, sharp-tailed grouse, prairie dog towns, mountain plover and mule deer) during 2005 on Fidelity Exploration & Production Company's proposed CBNG drilling areas located in Big Horn County, Montana. Seventy-five raptor nest sites were located in the area (Table 3-46).

In addition, one bald eagle nest was located just outside the 1-mile buffer of the Coal Creek and Pond Creek PODs. Seventy-nine bald eagles were observed during the three winter surveys, 46 of which were on or within 1 mile of the PODs. Other survey results include the identification and monitoring of 26 sage-grouse leks, eight of which were active; 29 sharp-tailed grouse leks, six of which were active; and 33 black-tailed prairie dog colonies. No mountain plovers or their signs were observed. A total of 369 mule deer and 168 pronghorn were recorded on and around the Dry Creek POD area during the three winter surveys.

9. Mule Deer Survey on the Southern Portion of the Northern Cheyenne Reservation and Adjacent Public and Private Lands, 2004

Mackie (2004) surveyed mule deer on the southern portion of the Northern Cheyenne Reservation and adjacent public and private lands south of the reservation boundary from April 27 to 29, 2004. The surveys covered approximately 250 square miles. Two hundred forty-seven mule deer were observed, 35 (14 percent) of which were recorded on the Northern Cheyenne Reservation.

TABLE 3-45

RAPTOR NESTS LOCATED IN THE FIDELITY'S COALBED NATURAL GAS DEVELOPMENT AREAS IN BIG HORN COUNTY, MONTANA 2002

Species	Total Number of Nests	Active Nests (during the May surveys)
Red-tailed hawk	37	17
Golden eagle	8	3
Bald eagle	2	2
Prairie falcon	7	0
Osprey	1	0
American kestrel	1	0
Great-horned owl	6	3
Burrowing owl	6	5
Unidentified raptor	2	0

Source: Hayden-Wing Associates baseline and monitoring surveys for wildlife (2004)

TABLE 3-46

RAPTOR NESTS LOCATED IN THE FIDELITY'S COALBED NATURAL GAS DEVELOPMENT AREAS IN BIG HORN COUNTY, MONTANA 2005

Species	Total Number of Nests	Active Nests (during the May surveys)
Red-tailed hawk	33	19
Golden eagle	10	4
Bald eagle	2	2
Prairie falcon	7	1
Osprey	2	1
American kestrel	1	0
Great-horned owl	11	6
Burrowing owl	7	2
Unidentified raptor	2	0

Source: Hayden-Wing Associates baseline and monitoring surveys for wildlife (2005)

10. Raptor Inventory and Monitoring Report, Powder River County, BLM Miles City Field Office 2005

During 2005, raptor monitoring and inventory for the BLM MCFO were conducted in Powder River County. Ninety-seven raptor nests were located in the area (Table 3-47).

11. Raptor Survey and Inventory for Big Horn County, Montana, conducted for BLM Miles City Field Office, 2004

Greystone Environmental (2004a) completed a raptor survey and inventory covering 376,000 acres of suitable nesting habitat (cliffs, rims, buttes, cottonwood/riparian areas, green ash draws, etc.) within Big Horn County, Montana.

Aerial surveys were conducted on two days in May 2004 and ground surveys were conducted over four days in May 2004. Thirty-five raptor nests were located in the area (Table 3-48). In addition, one sharp-tailed grouse lek was documented.

TABLE 3-47

RAPTOR NESTS LOCATED DURING THE POWDER RIVER COUNTY SURVEYS, 2005*

Species	Total Number of Nests	Active Nests	Total Number of Young
Red-tailed hawk	25	24	40+
Golden eagle	14	7	10+
Ferruginous hawk	4	1	N/S
Prairie falcon	5	3	N/S
Great-horned owl	4	3	N/S
Unidentified raptor	45	7	12+

*Source: BLM raptor monitoring and inventory (Greystone Environmental Consultants 2005)

N/S = not specified in report.

TABLE 3-48

RAPTOR NEST FOUND DURING THE BIG HORN COUNTY SURVEYS, 2004

Species	Total Number of Nests	Active Nests	Total Number of Young
Red-tailed hawk	21	10	?
Golden eagle	3	3	6
Bald eagle	1	1	3
Osprey	4	4	?
Great-horned owl	3	3	?
Barn owl	1	1	?
Burrowing owl	1	1	?
Unidentified raptor	1	0	0

Source: Greystone Environmental raptor survey and inventory (May 2004a)

12. Mountain Plover Habitat Evaluation and Survey and Black-tailed Prairie Dog Survey - Big Horn, Powder River and Rosebud Counties, Montana, 2004

Greystone Environmental (2004b) completed a mountain plover habitat evaluation and survey, as well as black-tailed prairie dog surveys, in Big Horn, Powder River and Rosebud Counties. Aerial surveys for black-tailed prairie dogs were conducted over two consecutive days in February 2004 and ground surveys for prairie dogs were conducted over five consecutive days in May 2004. Aerial surveys documented 100 black-tailed prairie dog colonies previously documented by BLM from 2001 to 2003. Four of the colonies previously documented by BLM were not present and 59 new colonies were located. Of the colonies located through aerial surveys, all but eight were active. The ground surveys documented 28 active prairie dog colonies and 5 inactive colonies.

Mountain plover habitat surveys were conducted in May 2004 and surveys for mountain plovers were conducted over five consecutive days during the same month. No mountain plovers were observed and habitat surveyed indicated there was little potential mountain plover habitat in the area.

13. 2005 Bald Eagle Winter Observations in the CBNG area

Hayden-Wing and Associates documented the following wintering bald eagle observations in the CBNG area over four days of surveys in January and February 2005:

- 24 bald eagle observations on January 6
- 15 bald eagle observations on January 25
- 36 bald eagle observations on February 22
- 4 bald eagle observations on February 23

14. 2005 Mule Deer Observations in the CBNG area.

Hayden-Wing and Associates documented the following wintering mule deer observations in the area of Fidelity's CBNG holdings in Bighorn County, Montana over three days of surveys in January and February 2005:

- 95 mule deer on January 6
- 119 mule deer on January 25
- 160 mule deer on February 22

Additional observations included 95 pronghorn on January 6, 57 pronghorn on January 25 and 16 pronghorn on February 22.

15. Coalbed Natural Gas Program Wildlife Monitoring and Protection Plan, 2003 Annual Report

The 2003 annual report for the Coalbed Natural Gas Program Wildlife Monitoring and Protection Plan (Rau 2004) provided information on the following surveys not discussed in previous text:

Breeding Birds

One hundred four bird species were observed in June to August 2002 surveys on the Forks Unit of the Padlock Ranch. Thirty-seven bird species were observed in a June 2001 study in the Decker area. Forty-nine bird species were observed in a different study in the Decker Montana area during the 2002 field season.

Sage-grouse

- BLM completed comprehensive sage-grouse lek surveys in 2003. All known sage-grouse lek locations between the Crow Indian Reservation and the Powder River were aerially searched by helicopter. Forty-two known lek locations were surveyed, with 13 active leks, found with 109 sage-grouse counted.
- BLM completed winter surveys focusing on sagebrush habitats within core CBNG development areas in 2002/03. Approximately 41,000 acres of potential sage-grouse winter habitats were surveyed and eight winter flocks totaling 173 individual birds were observed.

16. Coalbed Natural Gas Program Wildlife Monitoring and Protection Plan, 2004 Annual Report

The 2004 Annual Report for the Coalbed Natural Gas Program Wildlife Monitoring and Protection Plan (BLM 2004a) provided information on the following surveys not discussed in previous text

Bald Eagles

- The Tongue River was surveyed for bald eagle nest occupancy and new territory establishment in spring 2004. Three active nests were located between the Wyoming state line and Birney, Montana. Two of these nests are within current or proposed CBNG project areas. One new territory was identified. However, the nest associated with this territory was apparently abandoned later in the spring.
- BLM conducted three wintering bald eagle surveys between January 14 and March 4, 2004. Preliminary results include sightings of 15, 17 and 50 eagles, respectively, in the three surveys.

Sage-grouse

- A comprehensive landscape-level sage-grouse lek survey was not conducted in 2004. However, all leks within current and near-future CBNG development areas were intensively surveyed. Seven leks were observed in these areas.

Black-footed Ferret

- Project proponents were required to complete black-footed ferret surveys on nine prairie dog colonies totaling 550 acres within CBNG development areas. No ferrets or sign were observed.

17. Coalbed Natural Gas Program Wildlife Monitoring and Protection Plan, 2005 Annual Report, Draft

The Draft 2005 Annual Report for the Coalbed Natural Gas Program Wildlife Monitoring and Protection Plan (BLM 2005b) provided information on the following surveys not discussed in previous text.

Mule Deer

- A second spring mule deer survey was conducted over two days in April 2005 on the southern portion of the Northern Cheyenne Reservation and adjacent public lands. Two hundred twenty-one mule deer were observed. Twenty white-tailed deer and forty-six pronghorn were also observed. Most (mule deer and pronghorn were observed on private and public lands south of the reservation boundary.

Sage-grouse

- Surveys conducted by BLM and contractors for CBNG development companies within the

CBNG development area recorded12 sage-grouse leks, 11 of which were active.

- Winter surveys could not be conducted due to inadequate snow cover.

18. Maximum Number of Males/Lek, CBNG Monitoring, Montana, 2000 to 2005

The Draft 2005 Annual Report for the Coalbed Natural Gas Program Wildlife Monitoring and Protection Plan (BLM 2005b) lists the maximum number of males/leks for 28 sites in the CBNG monitoring area. Each lek site was monitored at least once between 2000 and 2005. For the six leks within POD/mine boundaries, two of the sites were inactive and the maximum number of males for the other four sites ranged from 5 to 55. For the seven leks outside, but within 2 miles of POD/mine boundaries, three of the leks were inactive and the maximum number of males for the other four leks ranged from 8 to 14. For the 15 leks located more than 2 miles from the POD/mine boundaries, 5 were inactive and the maximum number of males for the other 10 sites ranged from 7 to 29.

Aquatic Resources

Aquatic habitat in the CBNG Planning Area that supports, or could potentially support, fisheries and other aquatic resources briefly described in the following paragraph includes rivers, streams, lakes and stock ponds. Extensive information on aquatic habitat and fisheries resources in the Billings and Powder River RMP areas is contained in the Montana NRIS on the Internet at http://nris.state.mt.us/wis/mris1.html (Montana State Library NRIS 2005).

Tables WIL-2 through WIL-4 in the Wildlife Appendix summarize representative Planning Area information from the Montana State Library NRIS (2005) Internet data base. Table WIL-2 summarizes aquatic resources characteristics of major drainages and representative tributaries within the boundaries of each RMP area. These characteristics include drainage length, aesthetics, fisheries management, fisheries resource value, number of fish species present and whether a dewatering problem has been identified. The relative abundances of fish species present in major drainages and representative tributaries are summarized in Table WIL-3 (Billings RMP area) and WIL-4 (Powder River RMP area). The scientific names of fish species discussed in the following text are given in Tables WIL-3 and WIL-4.

While additional fish sampling has occurred in the Planning Area and throughout the state, long-term trends are difficult to identify because scant data exist for baseline biological and ecological conditions. The Statewide Document identified the number of fish species found in the various streams and stream reaches within the Planning Area (Table WIL-2). While additional sampling can identify new or previously unrecorded species in a stream, this is not necessarily an indication of a long-term change or evidence that a species no longer occurs in that stream. Species do not necessarily occupy a stream or stream reach throughout the year, so sample timing can have a substantial influence on sampling results. The particular sampling methods can also influence the results, as each method varies in effectiveness based on environmental conditions and species present.

Only when sampling is conducted in the same reach, at the same time of year and with similar methods can some relative inference be obtained regarding long-term changes. Annual variation can, however, confound even these results. Therefore, while the number of species identified in the various Planning Area streams may have changed since the Statewide Document (see WIL-2), the numbers tend to increase rather than decrease. Such increases result from the identification of previously unrecorded species, while there typically is no definitive information regarding the loss of a species.

Numerous other aquatic resources besides fish are present in Planning Area water bodies. These resources often are important in the diet of various species of fish, or they comprise part of the food web that fish ultimately depend on in their diet. Examples of other aquatic resources include benthic macroinvertebrates and microinvertebrates, zooplankton, phytoplankton, periphyton (attached algae), snails, clams and worms. Numerous taxa of aquatic insects whose distribution and abundance vary with geographic location, habitat type and habitat condition occur in Planning Area drainages. Immature and adult forms of Plecoptera (stoneflies), Ephemeroptera (mayflies), Trichoptera (caddisflies) and Diptera (true flies) are particularly important in the diets of juvenile and adult trout, whitefish and other native fish species.

Fish and other aquatic species listed, proposed, or are candidates for listing as federally endangered or threatened species, or have otherwise been designated as federal or state sensitive species or species of concern, are discussed under Special Status Species in this Aquatic Resources section.

Billings RMP Area

Major rivers and streams in the Billings RMP area are the Yellowstone River and its tributaries in the southern two-thirds of the area and the Musselshell River and its tributaries in the northern one-third of the area. Both of these rivers eventually drain to the Missouri River outside of the RMP area. Major tributaries to the Yellowstone River are the Boulder,

Stillwater, Clarks Fork of the Yellowstone and Bighorn rivers. Careless Creek is a major tributary to the Musselshell River. Each of the referenced drainages is characterized by a dendritic pattern of tributaries, with flows ranging from perennial to ephemeral (MBOGC 1989). Examples of other water bodies that provide important habitat for aquatic resources in this resource management plan are Bighorn Lake, Cooney Reservoir, Big Lake, Lebo Lake, numerous mountain lakes at higher elevations and miscellaneous water bodies such as storage reservoirs and stock ponds.

The Billings RMP area drainages listed in Table WIL-2 have been characterized as ranging from "national renown" in the more upstream reaches to "stream and area fair" in some of the downstream reaches (Montana NRIS 2001). Designated fisheries management in these drainages is for trout, except in the Yellowstone River east of Billings (managed for warm/cool water and non-trout species) and in the downstream section of the Clarks Fork of the Yellowstone (managed for non-trout species) (see Table WIL-2). The fisheries resource value in these drainages is outstanding, high, or substantial, except in the Little Bighorn River (moderate value) and Careless Creek (moderate or limited value in some reaches). The greatest numbers of fish species are generally found in the more downstream reaches of larger drainages, with comparatively fewer species present in the more upstream, or upstream reaches of, tributaries. Numbers of fish species present vary from 32 in the Musselshell River, 28 in the Yellowstone River east of Billings, 20 in the Yellowstone River west of Billings, 9 in the Boulder and Stillwater rivers and 8 in the Little Bighorn River (see Table WIL-2).

Table WIL-3 provides detail about the relative abundance of fish species collected from each of the Billings RMP area drainages listed in Table WIL-2. Many of the same fish species are abundant or common in many of these drainages, although there is a pattern, proceeding downstream, of increased species diversity and the replacement of predominantly cold-water species by cool and warm water species. Examples of abundant or commonly occurring game fish in the Yellowstone River west of Billings are rainbow trout, brown trout, mountain whitefish and burbot (ling); abundant or common non-game fish species in this reach of the Yellowstone River include, among others, goldeye, longnose sucker, white sucker, mountain sucker, shorthead redhorse and mottled sculpin (see Table WIL-3).

The same species of trout and whitefish, as well as Yellowstone cutthroat trout and brook trout, also are abundant or common in the Boulder and Stillwater rivers. By comparison, these same species of salmonids are either uncommon in occurrence or absent from the mainstem Yellowstone River east of Billings. Instead, game fish typically associated with cool or warm water regimes—such as channel catfish, northern pike, smallmouth and largemouth bass, yellow perch, sauger and walleye—first appear in river collections or are more abundant than farther upstream (see Table WIL-3).

Fish species present in the Clarks Fork of the Yellowstone and in the Bighorn River generally represent a subset of fish species present in nearby reaches of the Yellowstone River. There are more fish species present in the downstream sections of the Clarks Fork (19 species) and the Bighorn (30 species) than in their upstream sections (12 species in the Clarks Fork and 17 species in the Bighorn) (see Table WIL-2). Rainbow trout, brown trout and mountain whitefish are present in both sections of the Clarks Fork and Bighorn rivers, but these game species are more abundant in the upstream than downstream sections (see Table WIL-3). Yellowstone cutthroat trout also are present in the Clarks Fork and Arctic grayling are present in the upstream section of the Clarks Fork. Other game species present in these two drainages include channel catfish, burbot and sauger in the downstream section of the Clarks Fork and channel catfish, northern pike, burbot, smallmouth bass, sauger and walleye in both sections of the Bighorn River. The Little Bighorn River, which is tributary to the downstream section of the Bighorn River, supports five commonly occurring game fish species, including rainbow trout, brown trout, mountain whitefish, channel catfish and smallmouth bass
(see Table WIL-3).

A variety of 32 fish species are present in the Musselshell River within the Billings RMP area (Table WIL-2). More than half of these species have been rated as abundant or common in occurrence in various fisheries studies conducted on this drainage (see Table WIL-3) (Montana NRIS 2001). Examples of game species present in the Musselshell, which is managed as a trout fishery within the RMP area, include brown trout, mountain whitefish, channel catfish, black bullhead, northern pike, smallmouth bass, sauger and walleye. Examples of dominant non-game species present in the Musselshell are goldeye, common carp, sand shiner, flathead chub, longnose dace, longnose sucker, white sucker, mountain sucker, shorthead redhorse and mottled sculpin. The 10 species of fish present in Careless Creek, a tributary to the Musselshell, are dominated by non-game fish, such as lake chub, fathead chub, longnose dace and white sucker. The only game fish reported from Careless Creek is brook trout, which is common in occurrence (see Table WIL-3).

Some of the storage reservoirs and stockponds in the Billings RMP area and in other Planning Area reservoirs and stockponds, have been stocked with

various game fish species. Examples include northern pike, largemouth bass, yellow perch, walleye, bluegill, crappie and rainbow trout (MBOGC 1989, BLM 1995). Rainbow trout must be restocked regularly because they will not reproduce in ponds, but other species such as bass, perch, bluegill and crappie may establish self-sustaining populations in ponds.

Water quality in perennial rivers and streams within the Billings RMP area is generally good. Water quality in the Yellowstone River has been rated as good for wildlife uses, while water quality in the Musselshell River has been rated as satisfactory for wildlife uses (BLM 1995). The BLM (1995) also reported that the area's semi-arid climate is not conducive to maintaining fish habitat and populations in most intermittent streams. However, Regele and Stark (2000), citing the Montana Fish, Wildlife and Parks (MFWP), stated that perennial as well as intermittent prairie streams in southeastern Montana are important in the life histories of native fish species and often provide spawning and rearing habitat for mainstem fish species.

Powder River RMP Area

Major rivers and streams that comprise important aquatic habitat in the Powder River RMP area are the Yellowstone River and its tributaries in the western two-thirds of the area and the Little Missouri River and its tributaries in the eastern one-third of the area. All of these rivers eventually drain to the Missouri River outside of the RMP area. Major tributaries to the Yellowstone River are the Tongue (and Tongue River Reservoir), Little Powder and Powder rivers and Rosebud, Pumpkin, Otter, Armells, Hanging Woman and Mizpah creeks. Box Elder Creek is a tributary to the Little Missouri River. The referenced drainages are characterized by a dendritic pattern of perennial and ephemeral tributaries (MBOGC 1989). Examples of other water bodies that provide habitat for aquatic resources in this RMP area are lakes, storage reservoirs and stock ponds.

The Powder River RMP area drainages listed in Table WIL-2 have been characterized as typically ranging from "clean stream and natural setting" to "stream and area fair," although the Powder River varies from "natural and pristine beauty" in the upstream section to "low" in the downstream section (Montana NRIS 2001). Fisheries management in these drainages is primarily for non-trout species, warm/cool water species, or has not been designated. One exception is in the upstream section of the Tongue River, including the 10-mile reach immediately downstream of the Tongue River Dam, where designated fisheries management is for trout. Relatively cool water released from the Tongue River Dam allows rainbow and brown trout to occupy the upper 10 miles of the reach immediately downstream of the Tongue River Dam. However, high water temperatures, flow fluctuations, predation and habitat conditions limit natural reproduction of these two species throughout much of the rest of the lower Tongue River (BLM 2004b). As a result, these trout populations exist and are maintained with a stocking program by MFWP. The rainbow trout stocking program likely contributes little to natural production, because the natural spring spawning timing has been shifted from the spring to the fall for the hatchery stock. Lack of success for brown trout spawning is due to (1) brown trout migrate downstream during cooler temperatures to feed and then get caught in natural warm stream temperatures and end up perishing below the 10 mile reach that can support trout and (2) there is a limited amount of deep pool habitat for fish to hold over in during low flows. In addition to these two trout species, the reach downstream of the Tongue River Dam supports recreational fisheries for smallmouth bass, sauger, walleye and channel catfish (BLM 2005c, d).

Nineteen fish species recently have been documented in the Tongue River Reservoir and fourteen species occur upstream of the reservoir (BLM 2005c). The primary species occurring in these areas include black crappie, white crappie, walleye, smallmouth bass, sauger, northern pike and channel catfish. In addition, sauger is the only sensitive species in these areas of the Tongue River (BLM 2005c).

The fisheries resource value in most of the Powder River RMP drainages is high, substantial, or moderate, except in some reaches of Pumpkin and Mizpah creeks that have limited fisheries resource value. The greatest numbers of fish species are generally found in the downstream reaches of larger drainages, with fewer species typically present in the more upstream reaches or in smaller tributaries. Numbers of fish species present vary from 40 in the Yellowstone River and 33 in the downstream section of the Tongue River to 13 in the Little Powder River and 18 in the Little Missouri River (see Table WIL-2).

Table WIL-4 provides detail on the relative abundance of fish species collected from many of the Powder River RMP area drainages listed in Table WIL-2. The number of fish species in this reach of the Yellowstone River (40 species) is considerably greater than in the Yellowstone River reach within the Billings RMP area, either east of Billings (28 species) or west of Billings (20 species). The most abundant game fish in the Yellowstone River in the Powder River RMP area are shovelnose sturgeon, paddlefish, channel catfish, burbot, sauger and walleye. Lesser numbers of a wide variety of other game species also are present, such as

northern pike, smallmouth and largemouth bass, white and black crappie and rainbow and brown trout. Examples of some of the more abundant non-game species in the Yellowstone River are goldeye, common carp, emerald shiner, flathead chub, river carpsucker, white sucker, shorthead redhorse and stonecat. The federally listed endangered pallid sturgeon occurs rarely in the Yellowstone River within this RMP area (see Table WIL-4).

Species present in tributaries to the Yellowstone River within the Powder River RMP area generally overlap with those species present in the mainstem Yellowstone. However, species composition in the tributaries is less diverse overall, particularly in the smaller drainages and in the upstream sections of drainages (see Table WIL-4). Some of the fish species dominant in the Yellowstone River are also prominent in sections of the Tongue and Powder Rivers include shovelnose sturgeon, channel catfish, sauger, goldeye, common carp, flathead chub, white sucker and shorthead redhorse (Montana NRIS 2002). However, recent sampling found no common carp, shovelnose sturgeon, sauger, shorthead redhorse, or white sucker at any of the four lower Powder River sampling sites in Montana and no goldeye, shovelnose sturgeon, or sauger were found at any of the five lower Tongue River sites (USGS 2005a). While this suggests a decrease in diversity in these reaches, these fish are migratory species that typically occur in the tributary areas only for relatively short periods of time (i.e., spawning periods). Therefore, the inconsistent sampling results are likely due to sampling bias related to the timing of the sampling, as well as the sampling methods used. The size and turbidity of these rivers also contribute to the variable effectiveness of different sampling methods.

Other species present in the Tongue and Powder rivers include northern pike, walleye, several species each of bullheads, sunfishes and crappies in the Tongue River; burbot, green sunfish and walleye in the Powder River; and rainbow and brown trout, which are uncommon in occurrence, in the upstream sections of the Tongue and Powder rivers (see Table WIL-4). Smallmouth bass, a popular cool water game fish, have been captured at various locations throughout the Tongue River and are reported to be abundant in Tongue River Reservoir (Montana State Library NRIS 2002).

Considerably fewer game species are present in the smaller Powder River RMP area tributaries. For example, the only game species reported as common in occurrence are channel catfish, northern pike, burbot and sauger in Rosebud Creek, which drains directly to the Yellowstone; channel catfish in Pumpkin Creek, which is a tributary to the downstream section of the Tongue River; and channel catfish in the Little Powder River, which is tributary to the downstream section of the Powder River (Montana State Library NRIS 2001) (see Table WIL-4). The Little Missouri River, which empties into the Missouri River, contains 18 fish species, including three game species (channel catfish, black bullhead and sauger) (see Table WIL-4).

Since the Statewide Document was completed, additional sampling has occurred within the Powder River RMP area. These results provide more detailed information regarding specific fish species within the Planning Area, as well as areas directly or indirectly affected by CBNG development facilities.

Confluence Consulting (2004) reported only two sturgeon chub at one Wyoming sampling location in the Powder River, while sampling in the early 1990s revealed sturgeon chub at considerably more Wyoming locations. Monthly sampling at 10 Powder River locations in Wyoming, between June and October 2004, resulted in no sturgeon chub collected (Zafft 2005a). However, sturgeon chub were collected at three of four Powder River sites in Montana (USGS 2005b).

Jaeger (2004) also reports the sauger distribution to be limited to the Yellowstone River, downstream of Rosebud Creek, but rare or absent in major tributaries such as Big Horn and Tongue Rivers and a small population is present in the Powder River. Sampling in 2004 and 2005 found no sauger in the Montana or Wyoming portions of the Tongue or Powder Rivers (Zafft 2005a, USGS 2005a). FWP (2005c) also reported that historically, the lower Tongue River facilitated a considerable sauger migration for spawning, but few migration movements have been evident in recent years.

Recent sampling within streams affected by CBNG development has also provided some specific information regarding changes in species composition and biodiversity possibly resulting from such activities. However, the complexity and uncertainties associated with determining biological effects are confounded by numerous factors. These factors include geologic, hydrologic and land use variations throughout the Planning Area. The effects of these factors, as well as their interactions, result in substantial variation in the biological, physical and chemical influences that might occur from CBNG development. Such variations affect the ability to sample the different aquatic habitats effectively and consistently, resulting in substantial uncertainty regarding species composition and distribution (Zafft 2005b). Other confounding factors are drought conditions that have occurred in the region for about the last six years. As a result, there are limited data to assess baseline population conditions accurately or to allow an assessment of potential CBNG effects.

Fish sampling in a number of Tongue River tributaries suggests fish in Squirrel Creek have a substantial

potential to be affected by CBNG development, primarily from impoundments located within intermittent and ephemeral draws that flow into the creek (BLM 2005d). The stream has not, however, been assessed to the extent needed to identify the specific cause(s) of habitat changes between sampling sites located upstream and downstream of CBNG development facilities. Despite these uncertainties, the data suggest an increase in dissolved solids and a marked decline in biological integrity ratings between the upper and lower reaches of Squirrel Creek. Conductivity increased by approximately a factor of four, while aquatic invertebrate taxa richness and fish numbers substantially decreased between the upstream and downstream sampling locations in 2002 (BLM 2005d). Preliminary results from sampling in 2004 suggest similar differences between these same sampling locations. While these changes could be the result of natural conditions, dissolved solids were substantially higher in the lower river site compared to 1970.

Sampson (2005) and MFWP (2006) reported the results of fish sampling in 2003, 2004 and 2006 at a number of sites where CBNG extraction was occurring in MFWP Region 7. Sampling occurred once in 2003 and twice (spring and summer) in 2004 and 2005. In addition, four of these sites had historical data compiled by Elser (1980). The recent sampling results indicate a decrease in species at two of these four historically sampled sites (Sampson 2005, MFWP 2006). One site in Pumpkin Creek showed a decrease from 10 to 4 species, with only white suckers occurring both historically and recently. There are currently no CBNG discharges to Pumpkin Creek. In contrast, fathead minnow was the only species captured in all three recently sampled years, but not historically. Confluence Consulting (2003) reported fathead minnow was among the most saline tolerant species in the Tongue River Basin.

Another site showing a substantial decrease in species over time was Sarpy Creek. This site showed a decrease from five species historically to one species (fathead minnow) in 2003 and 2005 (MFWP 2006). There are currently no CBNG discharges to Sarpy Creek. Two other sites (Hanging Woman and Rosebud creeks) showed a similar number of species, both historically and recently. Overall, fathead minnow were captured at most locations and in most years. Fathead minnow were found in 7 of 8 sites in 2003 and in 8 of 10 sites in 2004 and 2005. No other species were captured at more than four sampling sites in any of the three years. In addition, fathead minnow comprised 38 percent of all fish caught in 2004 and more than 72 percent in 2005.

Confluence Consulting (2004) found the Wyoming reach of the Powder River to have a high level of biological, chemical and physical integrity. It also maintained a mostly native assemblage of fish. These fish included flathead chub and sturgeon chub, which Confluence Consulting reported to be declining throughout their historic range.

Confluence Consulting (2004) reported 15 species of fish were captured in the Wyoming portion of the Powder River in 2002 and 2003, with flathead chub, plains minnow and sand shiner the most abundant species at most sampling locations. They also found abundant channel catfish at one location, suggesting some areas are important rearing areas for this species. While sampling in 2004 indicated flathead chub and sand shiner at all 10 Powder River sampling sites (6 in Wyoming and 4 in Montana), no plains minnow were captured (Zafft 2005a, USGS 2005a). Other frequently observed fish in the four Montana reach sites were channel catfish (four sites), plains killifish (three sites), river carpsucker (three sites) and longnose dace (two sites) (USGS 2005a).

Skaar et al. (2005) reported the presence and absence of native fish at six sites in the Powder River Basin, relative to where they would be expected to occur based on historic distributions and habitat conditions. They found sand shiner, white sucker and flathead chub at all the sites where they were expected to occur (and at least five of the six sites). However, lake chub, sauger and goldeye were found at fewer than 50 percent of the expected locations. Results from the Tongue River Basin were similar, although fathead minnow and mountain sucker were also absent from more than half of the areas where they were expected. This apparent widespread decline in the distribution of some native fish species suggests that a number of environmental factors may be affecting the presence of native fish in southeastern Montana.

While some data suggest that CBNG development might be affecting aquatic resources, a number of other factors also likely contribute to these apparent resource changes. These factors include coal mining, livestock grazing, agriculture/irrigation, dams/reservoirs, residential development and existing transportation systems (BLM 2004b, 2005d). No data are available, however, to quantify the effects of any of these factors on aquatic resources in the Planning Area. Drought conditions over the past several years also likely affected aquatic resources in the Planning Area.

Regarding other aquatic resources Confluence Consulting (2004) reports that the Powder River in Wyoming supports several rare macroinvertebrate species, which have been extirpated in other areas due to river modifications throughout the northern Great Plains. It also observed a marked decline in species diversity between samples obtained in the 1970s and 2002.

Aquatic invertebrate sampling was conducted at two sites on the Tongue River in 2003, near the state line and at Brandenburg Bridge. These data indicate ephemeroptera (mayfly) was the most abundant invertebrate species (62 percent and 49 percent at the two sites). Other

abundant species included Diptera (12 percent) and Coleptera (11 percent) at the state line site and Tricoptera (27 percent at Brandenburg Bridge (BLM 2005c).

The Aquatic Biota Monitoring Plan (November 9, 2006) has been developed by an aquatic task group for Montana and Wyoming. Members include representatives from BLM, MFWP, Wyoming Game and Fish, EPA, MDEQ, WYDEQ, MSU, USFWS and Montana Natural Heritage. The Aquatic Biota Monitoring Plan was developed in 2005 and has been implemented for aquatic species from 2005 to present. The plan addresses fish, macro-invertebrates, peryphyton, water quality, habitat, amphibians and reptiles. Monitoring results are not available at this time. However, preliminary research indicates the following.

Recent experiments have shown that increased concentrations of a salt compound (sodium bicarbonate) typically occurring in CBNG-produced water may be more toxic to some fish than previously estimated (Skarr et al, 2005). These data indicate significant mortality of newly hatched fathead minnow at concentrations greater than 400 mg/L. In contrast, similar experiments with white suckers indicated improved hatching and early survival at concentrations as high as 1,400 mg/L compared to control groups. Fifty percent mortality of white suckers occurred, however, at a concentration between 4,049 and 6,678 mg/L (Skarr et al. 2005). By comparison, CBNG wells in the Tongue and Powder River basins may average concentration of about 1,000 to 1,500 mg/L (Skarr 2006).

The Aquatic Biota Monitoring Plan will use a weight-of-evidence approach to determine effects on aquatic species. Triggers that would indicate a need for change in management would include the following: (1) fish kill, (2) losing or gaining species of fish, (3) gaining invasive species, (4) decrease in spawning runs, (5) acute and chronic toxicity of ions, (6) instream habitat loss, (7) avoidance of certain habitat types due to CBNG discharge, (8) large increases or decreases in temperature and (9) decrease in the score of 15 to 20 points for the index of Biological Integrity for fish assemblages (Bramblett et al. 2005). Information on aquatics monitoring is found in the Monitoring Appendix, Table MON-1.

Water quality conditions and concerns in perennial, intermittent and ephemeral drainages in the Powder River RMP area are generally similar to those described for drainages in the Billings RMP area. Water quality in the Yellowstone and Powder rivers has been rated as good for wildlife uses (MBOGC 1989).

Elser et al. (1980) reported the results of extensive fisheries investigations conducted on numerous large and small drainages in southeastern Montana. The authors found that the lower Yellowstone River in this part of the state supports a diverse, productive fishery that is dependent on adequate flows and good water quality. Elser et al. (1980) reported that in the Tongue River, fish populations range from a cold water-mixed population immediately downstream of the Tongue River Dam to an assemblage of slow-water species downstream near the river's mouth. They added that migrant fish species from the Yellowstone River depend on high spring flows to allow good passage into the Tongue River. Elser et al. (1980) noted that fish populations in the Powder River are limited in diversity and abundance because of water quality and water quantity conditions. Fish populations are probably limited for similar reasons in the Little Missouri River, which Elser et al. (1980) described as having highly erratic flows, fair to poor water quality, very hard water and moderate to high turbidities.

Special Status Species

Many federally listed threatened, endangered, or candidate species of special concern exist in the Planning Area and are given special consideration under Section 7(c) of the ESA of 1973. As required by the ESA, the USFWS has provided a list of endangered, threatened and proposed species that may be present in the Planning Area. This section reviews the habitat requirements of the one special status aquatic species identified by the USFWS (Table 3-49), as well as the likelihood of them being found in the 13 counties that may be potentially affected by this project.

While USFWS found that Yellowstone cutthroat trout did not warrant listing under ESA in 2001, a recent court ruling resulted in another status review to determine whether to propose listing the species as threatened or endangered (USFWS 2005a). This review process was completed in February 2006 with a determination that Yellowstone cutthroat trout did not warrant listing under ESA.

In addition to the federal special status species, seven other fish species expected to occur in the Planning Area are listed as sensitive species by BLM (Table 3-49). Sturgeon chub were, however, the only sensitive species captured in recent sampling in the Tongue and Powder River Basins (USGS 2005a, Zafft 2005a).

Montana Arctic Grayling

This species is a candidate for listing under the ESA. On October 2, 1991, a petition requested that the "fluvial Arctic grayling" be listed as an endangered species throughout its historic range in the lower 48 states. The petitioners stated the decline of the fluvial Arctic grayling was a result of many factors, including habitat degradation as a result of the effects of domestic livestock grazing and stream diversions for irrigation, competition with nonnative trout species and past overharvesting by anglers.

TABLE 3-49
SPECIAL STATUS AQUATIC SPECIES PRESENT IN THE CBNG PLANNING AREA

Common Name	Scientific Name	Habitat in Montana	Federal Status*
Montana Arctic grayling	*Thymallus arcticus*	Fluvial populations in the cold-water, mountain reaches of the Upper Missouri River	S
Pallid sturgeon	*Scaphirhynchus albus*	Bottom dwelling fish of the Missouri and Yellowstone rivers	E
Blue sucker	*Cycleptus elongatus*	Large rivers like the Missouri and Yellowstone, but spawn in tributaries	S
Northern redbelly X Finescale dace	*Phoxinus eos x P. neogaeus*	Boggy lakes, creeks and ponds, often with cool, dark-colored water	S
Paddlefish	*Polyodon spathula*	Calm open water of large rivers, such as the Missouri and Yellowstone Rivers	S
Pearl dace	*Semotilus/Margariscus margarita*	Cool or cold water lakes, bog ponds, creeks and springs	S
Sauger	*Sitzostedion canadense*	Large turbid rivers and shallow turbid lakes	S
Sturgeon chub	*Macrhybopsis gelida*	Turbid rivers with moderate currents and depths and sand or rock substrates	S
Yellowstone cutthroat trout	*Oncorhynchus clarki bouvieri*	Relatively clear, cold streams, rivers and lakes	S

*E = Federal Endangered; C = Federal Candidate; S = BLM Sensitive.

Additionally, the petition stated that much of the annual recruitment is lost in irrigation ditches. Historically, this species was widely, but irregularly, distributed and locally abundant above Great Falls in the upper Missouri River drainage in Montana (USFWS 1994c).

In 2007, USFWS determined the following: "currently available genetic information indicates fluvial Arctic grayling of the upper Missouri River drainage do not differ markedly in their genetic characteristic from adfluvial (lake or reservoir dwelling) Arctic grayling native to the Missouri River system. The fluvial Arctic grayling, therefore, is not considered biologically or ecologically significant based on genetics... Because the Service is unable to conclude at this time that the fluvial Arctic grayling populations of the upper Missouri River is significant, it does not qualify as a distinct population segment and is not a listable entity under the Act."

Pallid Sturgeon

This species was listed as endangered on September 6, 1990 (55 FR 36641). They evolved in large rivers with high turbidity and a natural hydrograph consisting of spring flooding and other natural highwater events. Historically in Montana, they occupied reaches of the Missouri River from Fort Benton downstream and in the Yellowstone River from about Forsyth (RM 183) to the Missouri River (USFWS 1993, Montana NRIS 2005). There are three priority recovery management areas in Montana, two on reaches of the Missouri and one on the Yellowstone River.

Blue Sucker

USFWS listed the blue sucker as a Category 2 species in 1994 and it was listed as a species of concern by the state of Montana in 1996. This species may be susceptible to population declines in Montana due to its slow maturity, relatively low recruitment rate, migratory life history and reliance on high flows in tributary streams for spawning. The blue sucker is found in the Missouri and Yellowstone Rivers, although blue suckers have also been found in many of the major tributary streams during their April to June spawning season. They prefer main channel swift water habitats. Where extensive riverine habitat losses and population isolation have occurred due to impoundments, however, major population declines and population fragmentation have resulted. In

Montana, the blue sucker is present in most places with available habitat. They are an indicator species for ecosystem health beeause of their habitat-specifie requirements.

Northern Redbelly x Finescale Dace

The northern redbelly x finescale daee hybrid is designated as a species of special concern in Montana, primarily due to its limited distribution. This unique species consists only of female fish, as the hybrid female breeds with redbelly daee males, but the genetic material of the redbelly daee is not passed on to the progeny. Thus, the progeny are clones of the female. Northern redbelly and fineseale dace prefer quiet water habitat in beaver ponds, bogs and clear streams, although fineseale daee are also found in larger lakes and reservoirs. The northern redbelly x finescale dace hybrid has a relatively limited distribution in thc Planning Area, primarily in the Yellowstone River drainage

Paddlefish

The paddlefish is a mostly cartilaginous fish with smooth skin and is closely related to the sturgeon. Males mature at about age 9 or 10, while females mature at age 16 or 17. Montana is home to one of few remaining self-sustaining populations. These long-lived game fish have low reproduetive rates, making them suseeptible to the effeets of habitat loss and reereational harvest. Beeause of its biological vulnerability, it was listed as a sensitive species in Montana in 1979. Paddlefish are more commonly found seasonally in the Upper Missouri River during the spawning season (May to July). In or near the CBNG Planning Area, they are found in the lower Missouri and Yellowstone Rivers. Paddlefish spawn during high water periods in late spring (May to June).

Pearl Dace

Pearl dace likely have a relatively limited distribution in the CBNG Planning Area. They have been found primarily in small, cold tributaries north of the Missouri River, with limited observations in the lower Yellowstone River. They are designated as a species of special concern in Montana, primarily because of their limited distribution. Pearl dace mature in two years and they spawn during the spring in clear water from 1 to 2 feet deep, over gravel and sandy substrate.

Sauger

The sauger is a game fish added to the Montana species of special eoncern list in June 2000 beeause of the recent widespread declines in populations throughout Montana. This designation reeognizes sauger as vulnerable to relatively minor disturbanees to its habitat and deserving of careful monitoring as to its status. A severe decline in sauger numbers was first notieed in 1989 and populations have remained low. Sauger fingerlings depend on normal summer flows for maintaining adequate nursery habitat in side ehannels and backwater areas. A combination of drought years, flow eontrol from the upstream dams and lack of woody cover in the rivers have eontributed to poor conditions for the survival of young sauger (Jaeger 2004). Adult sauger inhabit sand and gravel runs or sandy and muddy pools and backwater areas in small to large river systems. The sauger distribution within the Planning Area is limited primarily to the larger rivers and streams.

Sturgeon Chub

The sturgeon ehub is indigenous to the Missouri-Mississippi River Basins from Montana to Louisiana. The sturgeon chub is classified as a speeies of speeial eoneern in Montana because of its limited numbers and/or habitat, although reeent data show this species has a wide distribution in the Missouri, Yellowstone and Powder Rivers in Montana.

The biology of the sturgeon chub is not well known. It apparently spawns from June through July in waters from about 64 to 75 degrees (°F) (18 to 25° C). Chub are most closely associated with sites having moderate currents and depths and sand or rock substrates and they appear to be highly adapted to life in turbid waters. The major threat to the sturgeon chub is thought to be habitat alteration by dam and irrigation operations, as well as development. Low stream flows probably have eliminated some peripheral sturgeon chub populations, but dewatering poses little threat to the core populations of chubs in the Missouri and Yellowstone Rivers.

This species has persisted in the Powder, Yellowstone and Missouri Rivers during the recent years of drought in Montana, as well as in a few isolated tributaries. Recent sampling in the Tongue and Powder River Basins revealed the presence of sturgeon chub at only three sites in the lower Powder River (USGS 2005).

Yellowstone Cutthroat Trout

The Yellowstone cutthroat trout is one of two cutthroat trout subspecies in Montana and, as the name implies, is native to the Yellowstone River drainage of southwest and south-central Montana. Originally its range was as far downstream as the Tongue River, but today pure, unhybridized populations are limited to some headwaters streams and Yellowstone National Park.

The complex life-history behavior of many Yellowstone cutthroat trout populations requires movement among diverse habitats. Hence, disruptions in habitat quality or availability may reduce their diversity or lead to extinction of isolated populations.

Hybridization with non-native fish species is, however, considered the greatest threat to the persistence of Yellowstone cutthroat trout. The influence of other non-native organisms also threatens the persistence of Yellowstone cutthroat trout. Yellowstone cutthroat trout are susceptible to infection by *Myxobolus cerebralis*, a European protozoan and the causative agent of whirling disease (AFS 2005).

Other factors affecting Yellowstone cutthroat trout include irrigation, dam and culvert barriers, poor reservoir habitat, river channelization and rip rap, grazing, mining, logging and road building. Unfortunately, most remaining populations in Montana are isolated and are at risk of extinction from natural and human-caused events (AFS 2005).

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

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CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

Introduction

This chapter presents the environmental impacts from management actions described in Chapter 2. The descriptions of predicted effects that would result from the exploration, construction, operation and maintenance and abandonment activities associated with coal bed natural gas (CBNG) for each alternative is compared to the pre-project environment.

Chapter 4 contains an *Introduction, Analysis Assumptions and Guidelines* section and individual Resource Topic discussions. Table 2-3, in Chapter 2, summarizes and compares the impacts of the alternatives. The *Introduction* outlines the chapter and provides an explanation of the organization and creation of assumptions. The *Analysis Assumptions and Guidelines* section presents the Reasonably Foreseeable Development scenario (RFD) used to predict the level of CBNG development and addresses the analysis assumptions common to all alternatives. The Resource Topic discussions are organized alphabetically. Under each resource topic, the following are addressed: assumptions, impacts from management common to all alternatives and impacts from management specific to each alternative.

The duration of the impacts are analyzed and described as either short-term (up to 5 years) or long-term (greater than 5 years). Impacts from management of conventional oil and gas are found in the *Impacts from Management Common to All Alternatives* sections. Impacts from management of CBNG are found in the *Impacts From Management Specific to Each Alternative* sections.

The narrative describing the impacts from management specific to each alternative includes subsections summarizing the impacts to the Crow and Northern Cheyenne tribes, mitigation measures and a conclusions summary. The conclusion summarizes the cumulative impacts from other regional ongoing and foreseen projects.

Cumulative impacts consider the alternative in combination with other substantial existing and future developments in and near the Final Supplement to the Montana Statewide Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans (FSEIS) Planning Area, including oil and gas development projects, existing and future coal mines, new power plants, the Tongue River Railroad (TRR) and effects from Wyoming's CBNG development.

Project descriptions for activities considered in the cumulative impacts analysis are presented in the Minerals Appendix under Oil and Gas. Mitigation measures that are not already included as part of the alternatives are described and evaluated and the residual impacts are determined.

The resource discussions also address the differences between U.S. Bureau of Land Management (BLM) and State of Montana (state) impacts where divisions are meaningful. Physical impacts on landscapes from development disturbances can easily be quantified for Bureau of Land Management (BLM) and state regulated wells; however, effects on watersheds or wildlife from both BLM and state development cannot easily be distinguished and therefore are discussed in conjunction.

Analysis Assumptions and Guidelines

Analysis assumptions and guidelines provide common data to EIS team members to use when conducting the impact assessments for each resource. The assumptions and guidelines are based on previous events, experience of personnel and their knowledge of the resources in the Planning Area. The assumptions include the demand for various resources, the ability of the resources to meet the demand and how the actions will be carried out. An RFD was developed for this purpose and is discussed in the following sections.

Potential for Development—Reasonably Foreseeable Development Scenarios

The RFD addresses potential development on all lands, including the Crow and Northern Cheyenne reservations and the Ashland Ranger District of the U.S. Forest Service (USFS).

What has Changed in Chapter 4 Since the Draft SEIS (DSEIS)?

The impact analyses from the air quality and wildlife screens for Alternative H—Preferred Alternative were altered. The Air Quality and Climate section has additional changes, such as cumulative effects analysis from oil and gas development on climate change and also based on the completion of the supplemental air quality analysis (SAQA, BLM 2007).

The RFD is in no way stating that the BLM is making decisions for Indian lands or the USFS administered lands. For example, the decision to develop CBNG on Indian lands will be made by the Indian allottees and the tribes with concurrence of the Bureau of Indian Affairs (BIA), not by BLM.

The presumption of possible impacts to the environment is based on BLM guidance (BLM H-1624-1) provided for estimating the potential for oil and gas resources and for extrapolating the degree of development that is reasonably foreseeable over a given period of time. In the case of Montana's Powder River Basin and additional areas within the Billings and Powder River RMP areas, it is the level of CBNG development most likely to occur over the next 20-year period. The RFD is located in the Minerals Appendix, under "Reasonably Foreseeable Development Scenario". The following sections contain explanations of 1) the potential for CBNG resources within the Planning Area boundaries and 2) RFD for the different detailed development scenarios that are addressed by the various alternatives in this FSEIS.

Potential for CBNG Resources

An estimate of CBNG and conventional oil and gas resources was accomplished using many sources of information, including established files and databases, the BLM Resource Management Plans (RMPs) for the areas, coal information from the U.S. Geological Survey (USGS), professional and academic literature, available oil and gas maps, previous mineral assessments and expressions of interest and projections from the oil and gas industry. To project CBNG exploration and development, the areal extent of certain coals and the rank of coals in the CBNG emphasis area were considered.

Areas of subbituminous to bituminous coals were considered as the most likely to be explored and developed in Montana, although exploration and development has occurred mainly in subbituminous coal in the Wyoming portion of the Powder River Basin. The USGS produced an Open File Report (OF 96-92) showing the areas of coal, by rank, for the United States. This information indicates subbituminous and bituminous coals in many parts of the emphasis area. See Map MIN-1 in the Minerals Appendix for an illustration of this data and Map 4-1 for a geographical presentation of potential CBNG development within Montana.

Powder River, Rosebud, Custer and Big Horn counties contain the northern part of the Powder River Basin, which extends from Wyoming. Musselshell County has mostly subbituminous coal, while Carbon County has an extension of the Big Horn Basin coal, which is ranked as bituminous coal.

The amount of natural gas that could be produced from the coal beds in Montana has been projected to range from a low of 1 trillion cubic feet (TCF) (Crockett and Meyer 2001) to a high of 17.7 TCF (Nelson 2000). This and other information for Montana is used to predict where CBNG exploration is most likely to occur in the RMP areas. The RFD predicts the number of CBNG wells that would be drilled and completed during the next 20 years per alternative. By making these predictions, cumulative impacts can be assessed.

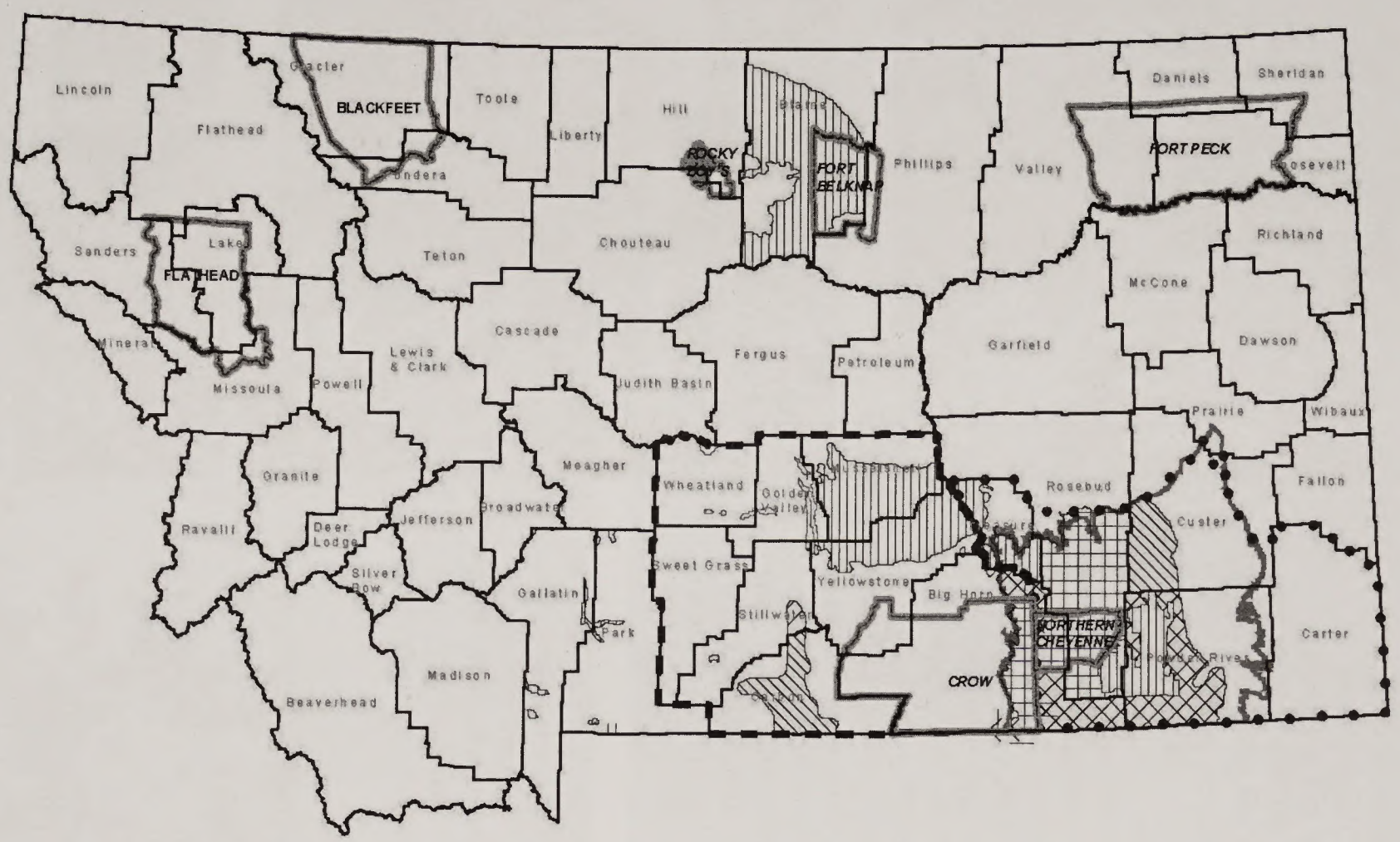
Reasonably Foreseeable Development Scenario

Projections of future CBNG development and production are difficult to make. Several variables complicate such forecasts, including new exploration, development or production techniques; increases or decreases in demand for natural gas; and price increases or decreases that may prompt larger or smaller development and production programs. For this FSEIS, a combination of historical trends, present activity, government and industry estimates and professional judgments were used in establishing the estimate of RFD. The RFD is discussed under three scenarios: restricted development, expanded development and phased development.

Restricted Development

Restricted development is applied to Alternative A. Under this scenario, the BLM would only approve exploration well permits and the state would only proceed with the development identified in the Stipulation and Settlement Agreement as presented in Chapter 2. With regards to the BLM exploration wells, an RFD of 200 wells per RMP area was assigned to provide a level of quantification for analysis; however, the BLM has no actual upper cap on issuing exploration well permits. The RFD numbers in no way represents a regulatory number for exploration wells that could be issued by the BLM.

Map 4-1: CBM Development Based on Reasonably Foreseeable Development Scenario



Legend

POTENTIAL CBM WELLS
- Minimal
- 1 - 150
- 151 - 400
- 401 - 700
- 701 - 4000
- 4001 - 7000

- Powder River RMP Area
- Billings RMP Area
- Native American Reservations

1:5,000,000

82,500 0 82,500 165,000 247,500 Meters

30 15 0 30 60 90 Miles

This map shows the maximum number of CBM wells as described in the Reasonable Foreseeable Development Scenario. NOTE: Development on this map has been confined to the regions with known sub-bituminous coal occurences.

DATA SOURCES:
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Reservations: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
Development Data: BLM Reasonable Foreseeable Development Scenario.

Expanded Development

Expanded development is considered for Alternatives B, C, D and E. Expanded refers to the number of potential wells based on known coal volumes that would be drilled in the RMP areas during the next 20 years, regardless of mineral ownership. Given the current oil and gas stipulations, the restricted development areas and the unknown geographical distribution of coal bed natural gas, it is unlikely that the maximum well density of 1 well per producing coal seam per 80 acres would be achieved. Map 4-1 indicates the predicted number of wells per county overlying known coal occurrences. The estimate for expanded development ranges from 10,000 to 26,000 wells drilled, the upper limit includes the reasonably foreseeable future activity (RFFA) estimates of 4,000 wells each for the Crow and Northern Cheyenne reservations and 200 wells for the Custer National Forest. The Powder River RMP area could host as many as 7,500 to 14,000 producing CBNG wells during the next 20 years. The RFD also estimated that 200 to 800 new conventional oil and gas wells could be drilled in the Powder River RMP area during the same time period. In the Billings RMP area, an estimated 1,000 to 2,400 producing CBNG wells could be installed. Conventional oil and gas wells are estimated to increase by 250 to 975 during this same time.

The expanded development estimate also predicted the number of potential field and sales compressors needed to export the gas. This level of development would require from 400 to 1,000 field compressors and from 50 to 100 sales compressors. Estimates for the gathering and sales lines are also included in the RFD.

Phased Development

Phased development of CBNG resources on federal leases is analyzed in three alternatives. Alternatives F and G describe high and low ranges for phased development of federal CBNG, while Alternative H (discussed in the following section) is the preferred alternative for phased development. The three alternatives also address cumulative impacts from the phased development of federal CBNG. Phased development differs from the expanded (full-field) development scenario because BLM would limit the number of approved federal Applications for Permit to Drill (APDs) by year and by geographic area. Alternative F would incorporate a limit based on the high range of development predicted within the RFD and Alternative G would incorporate a limit based on the low range of development predicted within the RFD. These two phased-development alternatives would consider wells per watershed instead of wells per county (Tables 4-1 and 4-2). The same high range predicted total number of potential state, private and federal wells based on known coal volumes that would be drilled under expanded development over the next 20 years, regardless of mineral ownership, would still apply to Alternative F. The constraints (multiple screens) imposed under the phased-development alternatives would limit the number of BLM-issued annual APDs to 5 percent of the total issued (RFD scenario rate of development). The projected rate of development identified in the RFD will be applied to state-approved APDs during the next 20 years. The resulting development rate for state wells was used to identify the pace at which BLM APDs could be approved within the 5 percent constraint. The assumed phased development rate for Alternatives F and G is shown in Tables 4-3 and 4-4. Figures 4-1 and 4-1A show the assumed development rates for Alternatives F and G.

Coal reserves indicate that 15 watersheds may be developed for CBNG over the next 20 years. Of these 15 watersheds, five hold most of the CBNG potential in Montana. These five watersheds are all located in the Powder River Basin (PRB).

The watershed screen is a combination of the RFD rate of development as applied to the CBNG wells approved by the state and an assumed 5 percent limit applied to federal wells. The use of this screen has resulted in the predicted number of APDs to be issued per watershed per year. The assumed order of watershed development was determined by proximity to existing development (southern watersheds within the PRB portion of Montana), operator plans of development (PODs) being prepared or being reviewed by an agency (see Figure 3-4 and 3-5) and areas with multiple coal seams.

Applying the 5 percent annual screen and the watershed screen increases the predicted 20-year development period by three years. For years 12 through 23, BLM would not issue the total 5 percent of APDs anticipated because the watershed screen would influence development.

Estimates for the total number of compressors needed to export the gas are the same as predicted in the RFD for each RMP area under Alternative F. Under Alternative G, however, the number of compressors needed would be 65 percent fewer than the amount proposed in the RFD.

TABLE 4-1

**PREDICTED APDS/WATERSHED UNDER ALTERNATIVE F
HIGH-RANGE, PHASED CBNG DEVELOPMENT**

	Watershed Name	State	BLM	Total
1	Clarks Fork Yellowstone	233	217	450
2	Little Bighorn	675	0	675
3	Little Powder	104	96	200
4	Lower Bighorn	414	386	800
5	Lower Tongue	1,786	1,664	3,450
6	Lower Yellowstone-Sunday	880	820	1700
7	Middle Musselshell	52	48	100
8	Middle Powder	1,087	1,013	2,100
9	Mizpah	65	60	125
10	Rosebud	1,863	1,737	3,600
11	Stillwater	52	48	100
12	Upper Musselshell	39	36	75
13	Upper Tongue	1,993	1,857	3,850
14	Upper Yellowstone-Lake Basin	414	386	800
15	Upper Yellowstone-Pompeys Pillar	104	96	200
	Total Predicted APDs	9,759	8,466	18,225

TABLE 4-2

**PREDICTED APDS/WATERSHED UNDER ALTERNATIVE G
LOW-RANGE, PHASED CBNG DEVELOPMENT**

	Watershed Name	State	BLM	Total
1	Clarks Fork Yellowstone	88	82	170
2	Little Bighorn	240	0	240
3	Little Powder	36	34	70
4	Lower Bighorn	145	135	280
5	Lower Tongue	626	584	1,210
6	Lower Yellowstone-Sunday	311	289	600
7	Middle Musselshell	21	19	40
8	Middle Powder	383	357	740
9	Mizpah	21	19	40
10	Rosebud	657	613	1,270
11	Stillwater	21	19	40
12	Upper Musselshell	16	14	30
13	Upper Tongue	699	651	1,350
14	Upper Yellowstone-Lake Basin	155	145	300
15	Upper Yellowstone-Pompeys Pillar	47	43	90
	Total Predicted APDs	3,464	3,006	6,470

TABLE 4-3

ALTERNATIVE F ASSUMED DEVELOPMENT RATE (APDS)

Year	Percentage	State/Private	BLM	Total Annual
1	3%	488	119	607
2	5%	586	324	910
3	6%	1,074	0	1,074
4	6%	1,170	0	1,170
5	6%	1,074	0	1,074
6	5%	781	129	910
7	5%	683	227	910
8	5%	488	422	910
9	5%	488	422	910
10	5%	390	520	910
11	5%	293	617	910
12	5%	293	613	906
13	5%	293	531	824
14	5%	293	531	824
15	5%	293	531	824
16	4%	244	460	704
17	4%	244	459	703
18	4%	244	410	654
19	3%	195	348	543
20	2%	145	299	444
21	3%	0	509	509
22	3%	0	496	496
23	3%	0	499	499
	100%	9,759	8,466	18,225
Low-end Total*		8,974	6,918	15,892

*Low-end total reflects the reduction of wells if no drilling occurs within the crucial sage habitat areas on both private and federal mineral estates.

FIGURE 4-1

ALTERNATIVE F ASSUMED DEVELOPMENT RATE

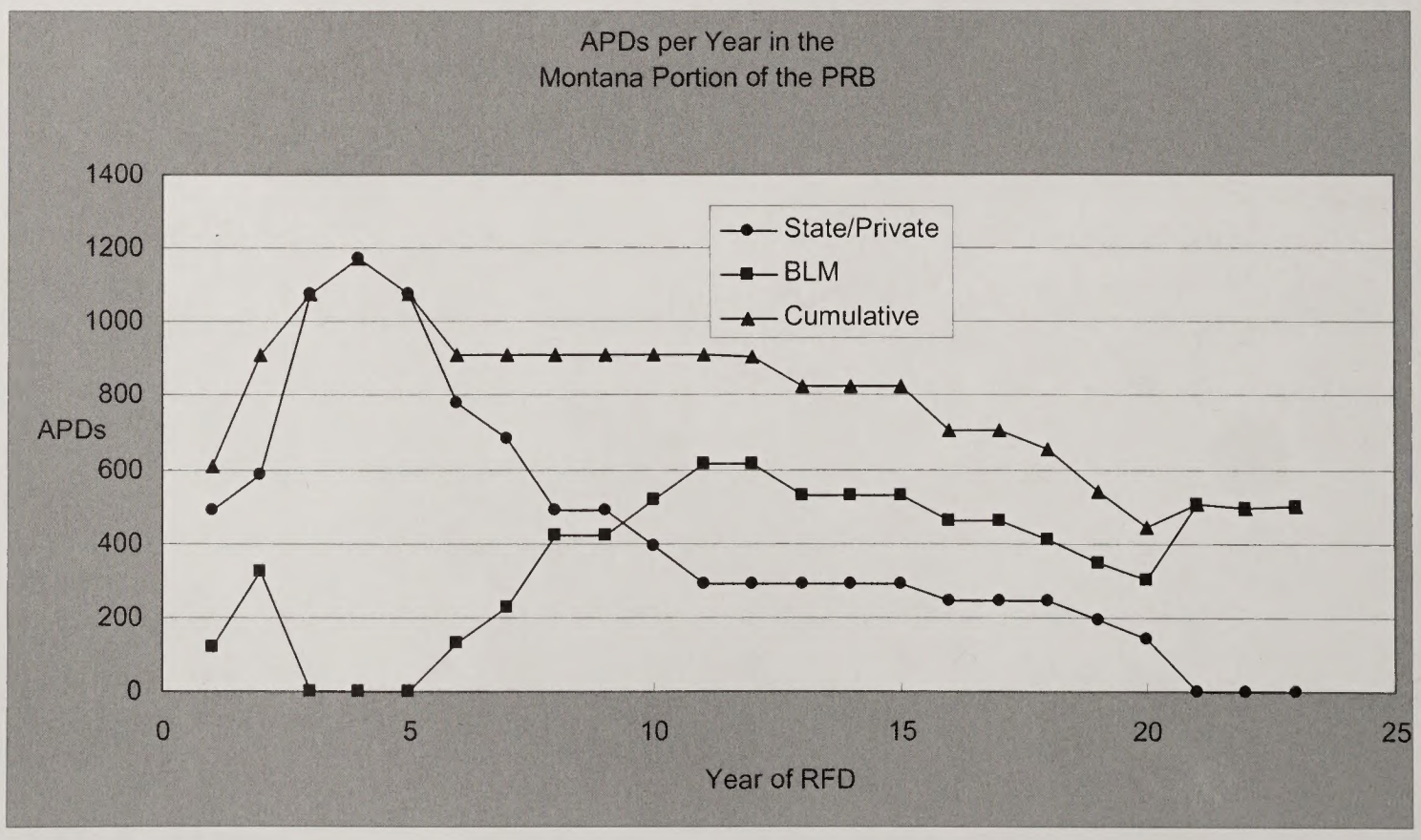


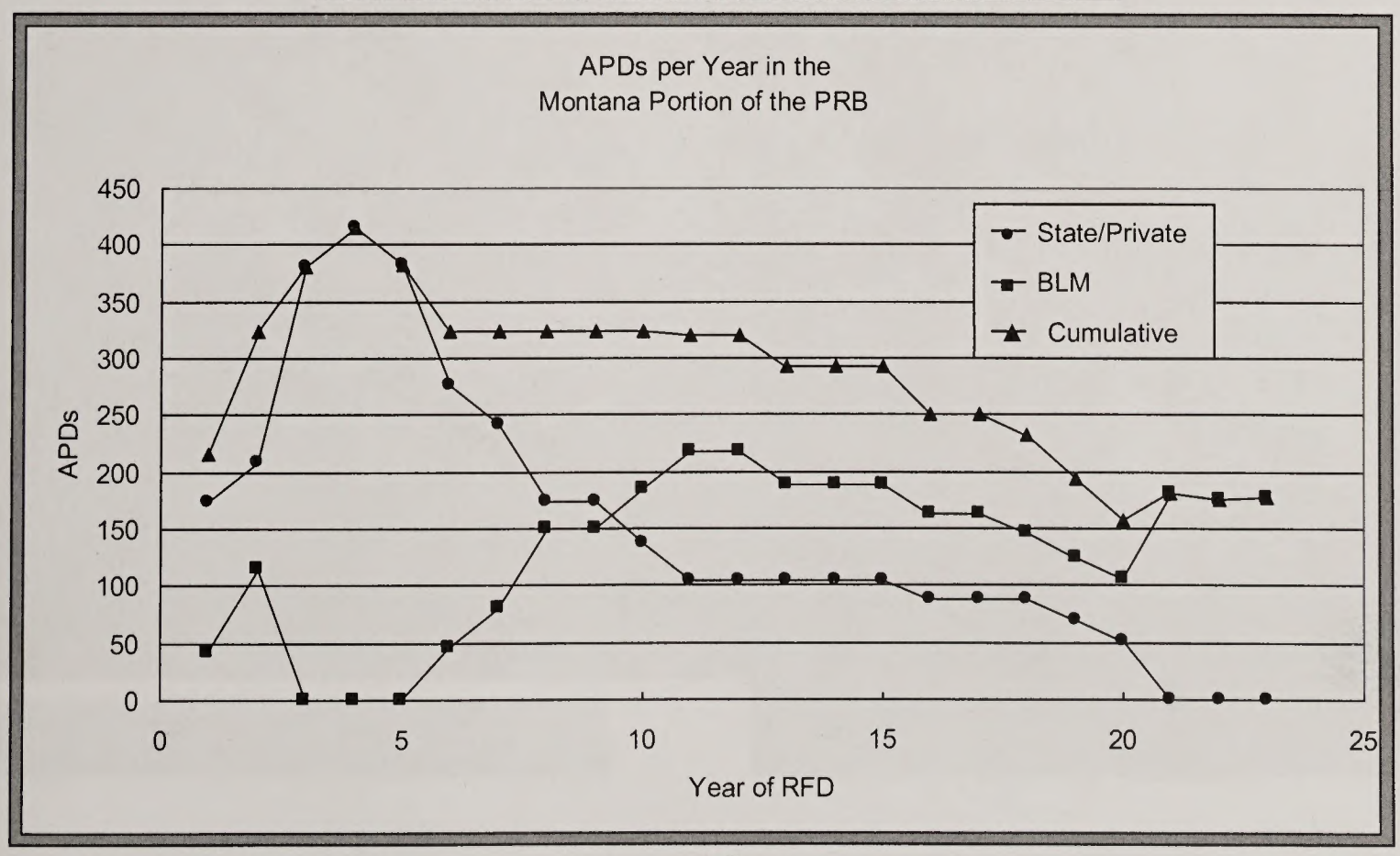
TABLE 4-4

ALTERNATIVE G ASSUMED DEVELOPMENT RATE (APDS)

Year	Percentage	State/Private	BLM	Total Annual
1	3%	173	42	215
2	5%	208	115	323
3	6%	381	0	381
4	6%	416	0	416
5	6%	382	0	382
6	5%	277	46	323
7	5%	242	81	323
8	5%	173	150	323
9	5%	173	150	323
10	5%	138	185	323
11	5%	104	217	321
12	5%	104	217	321
13	5%	104	189	293
14	5%	104	189	293
15	5%	104	188	292
16	4%	87	163	250
17	4%	87	163	250
18	4%	87	146	233
19	3%	69	124	193
20	2%	51	106	157
21	3%	0	181	181
22	3%	0	176	176
23	3%	0	177	177
	100%	3,464	3,006	6,470

FIGURE 4-1A

ALTERNATIVE G ASSUMED DEVELOPMENT RATE



Preferred Alternative Development

Development anticipated under Preferred Alternative H might differ slightly from the high-range, phased development scenario (Alternative F). The cumulative number of APDs per year would be similar; however, BLM could approve APDs each year and would not be restricted by the number of CBNG permits approved by the state. During the initial 5-year development period, BLM could issue APDs for federally administered minerals at a rate similar to permits issued by the state for private and state administered minerals. Furthermore, since BLM could issue APDs each year, the development scenario duration might be somewhat shorter than Alternative F at 23 years. The rate of development for approved state/private wells under the preferred alternative would be lower than predicted under the RFD. This is based on proposed federal wells associated with state-approved PODs Discussions with industry indicate future development would occur close to existing PODs characterized by high percentages of federal minerals (personal communication, Bruce Williams,, March 2006). Currently 367 federal APDs are pending approval within the boundaries of PODs previously approved by the state.

The preferred alternative would also consider wells per watershed instead of wells per county (Table 4-1), reflecting the phased development alternative; however the watershed screen would not be applied. The high-range, RFD-predicted total number of state, private and federal wells (18,225) would apply to the preferred alternative. The constraints (multiple screens) imposed under the preferred alternative would limit the impacts to key resources and would provide a process to determine if development proposals would have to be modified to alter the pace or place of development. The assumed rate of development for the preferred alternative over the next 21 years is identified in Table 4-5 and shown in Figure 4-2.

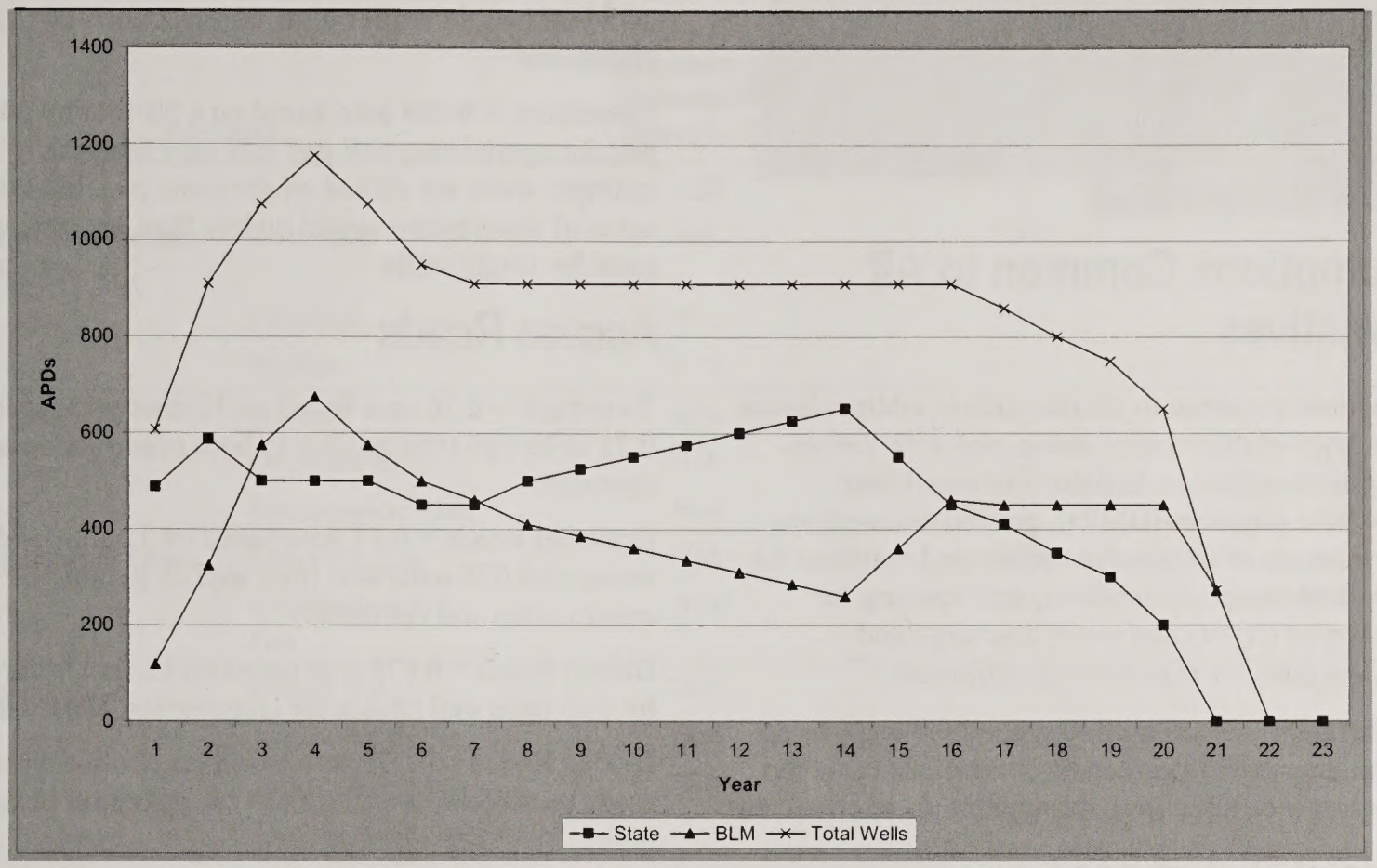
TABLE 4-5

PREFERRED ALTERNATIVE H ASSUMED DEVELOPMENT RATE (APDS)

Year	State/Private	BLM	Total Annual
1	488	119	607
2	586	324	910
3	500	575	1075
4	500	675	1,175
5	500	575	1,075
6	450	500	950
7	450	460	910
8	500	410	910
9	525	385	910
10	550	360	910
11	575	335	910
12	600	310	910
13	625	285	910
14	650	260	910
15	550	360	910
16	450	460	910
17	410	450	860
18	350	450	800
19	300	450	750
20	200	450	650
21	0	273	273
22	0	0	0
23	0	0	0
	9,759	8,466	18,225

FIGURE 4-2

PREFERRED ALTERNATIVE H ASSUMED DEVELOPMENT RATE



Estimates for the total number of compressors needed to export the gas are the same as predicted in the RFD.

The preferred alternative (Alternative H) differs from Alternative F as described below:

The preferred alternative would apply the condition on development in crucial sage-grouse habitat requiring no displacement of sage-grouse within crucial habitat areas. Specifically, the preferred alternative calls for maintaining the connectivity of the habitats, managing habitat to maintain healthy sage-grouse populations to serve as source populations and within the crucial sage grouse areas, maintain sage-grouse habitat so that population trends follow the general magnitude of decline or increase on control leks. BLM would work with operators, the Montana Board of Oil and Gas Conservation (MBOGC), the MFWP, the FWS and academia to identify best management practices/conditions of approval (BMPs/COAs) universally applied to all CBNG development in crucial habitat areas. This approach would identify BMPs, apply BMPs and monitor the effectiveness of BMPs. Should BMPs prove unable to meet the objectives of maintaining habitat connectivity and source populations for sage-grouse, additional or more stringent existing BMPs would be identified and applied.

In Alternatives F & H, the condition for allowable development within sage-grouse habitat areas (i.e., development cannot contribute to displacement of sage-grouse from crucial habitat areas) would probably lead to a lower number of wells drilled. The RFD predicted wells would be drilled on 80-acre spacing within the crucial sage-grouse habitat areas. Actual development in these areas might be significantly lower than predicted in the RFD. If operators chose to avoid all crucial habitat areas, approximately 2,333 fewer wells would be drilled. If the private minerals were fully developed within the crucial sage-grouse habitat areas, 1,549 fewer wells would be drilled.

To quantify impacts under Alternative F, the original RFD development numbers were used to assess impacts assuming operators could drill on current spacing and sage-grouse would not be displaced from habitat areas. Impacts were also quantified assuming no development would occur in these areas. This means 2,333 wells (with the associated roads, pipelines, compressors and produced water) would not be developed or installed. It also means gas would be left in place or drained from adjacent development. The most likely outcome would be somewhere between the full development and the no-development scenarios. Given the uncertainty associated with the effectiveness of alternative development scenarios regarding resource recovery, the low-end (no development) and high-end (full development) scenarios are used to bracket the impacts which would probably occur.

Alternative development scenarios could include a less-dense well pattern drilled within the habitat areas. Another potential scenario might be wells drilled on a denser spacing, but with fewer wells per year drilled within the habitat areas and no compressors installed on these sites. This does not suggest that these options would be viable, but rather points out that some level of development within the crucial sage-grouse habitat areas would probably occur.

Assumptions Common to All Alternatives

Assumptions common to all alternatives address issues such as level of disturbance associated with various development scenarios, implementation of best management practices (BMPs), general assumptions for percentages of alternative themes and numbers for various field equipment utilized, well spacing for production of CBNG and water discharge and drawdown rates for expanded development.

These assumptions are used to ground the analysis so that similar comparisons can be conducted across the various resource topics and throughout the alternatives.

Levels of Disturbance

In evaluating environmental impacts, criteria for determining quantitative impacts are required. Further, to facilitate some uniformity with respect to impact analyses, the following synopsis was prepared to give a general understanding of the resources necessary for the installation and production of a single CBNG well.

These values were determined from a variety of sources, including previous CBNG Environmental Assessments, discussions with BLM and state personnel, discussions with CBNG operators and information derived from the review of numerous applicable documents. However, actual references are not provided as these numbers were ultimately derived through internal analysis based on understanding of current and proposed CBNG activities in Montana and other areas (including Wyoming, Colorado, New Mexico, Arkansas, Alabama and Oklahoma).

The values presented in Table 4-6 can be scaled to accommodate the various scenarios being proposed for exploration, construction and operation phases.

The following descriptions outline the assumptions used to develop Table 4-6.

Well Sites

Construction = 0.25 acre based on a 105-foot by 105-foot pad for exploration, construction and drilling operations

Operations = 0.058 acre based on a 50-foot by 50-foot pad for operations, well pad size may increase if multiple wells are drilled on the same pad, but total acres of disturbance would be less than separate well pads for single wells.

Access Roads

Two-track = 0.30 acre based on 12-foot-wide roads by 0.21 mile/well (this applies to both construction and operation)

Graveled Roads = 0.11 acre based on 12-foot-wide roads by 0.075 mile/well (this applies to both construction and operation)

Bladed Roads = 0.075 acre based on 12-foot-wide roads by 0.05 mile/well (this is for construction phase only)

Bladed Roads = 0.090 acre based on 12-foot-wide roads by 0.06 mile/well (this is for operation phase only)

Bladed Roads = 0.75 acre based on 12-foot-wide roads by 0.5 mile/well (this is for exploration only)

Utility Lines

Water = 0.35 acre based on 15-foot by 0.20 mile/well (construction only)

Elec. Utility Overhead = 0.20 acre based on 10-foot by 0.15 mile/well (construction and operation)

Elec. Utility Underground = 0.35 acre based on 15-foot by 0.20 mile/well (construction only)

Transportation Lines

Low Pressure Gas = 0.90 acre based on 15-foot by 0.5 mile/well (construction only)

Intermediate Pressure Gas = 0.25 acre based on 25-foot by 0.08 mile/well (construction only)

Battery Site

Construction and Operation = 0.5 acre per battery site. Assume one battery site per field compressor. Disturbance per well = (0.5/24) = 0.020

Access Roads = 0.15 acre based on 25-foot by 0.050 mile per well during construction and operations

Field Compressors = 1 compressor per 24 producing wells

TABLE 4-6

LEVEL OF DISTURBANCE

Facilities		Exploratory Well Disturbance (acres/well)	Construction Disturbance (Short-term < 5-yr.) (acres/well)	Operation/Production Disturbance (Long-term >5-yr.) (acres/well)
Well Sites		0.25	0.25	0.05
Access Roads/ Routes to Well Sites	Two-track	N/A	0.30	0.30
	Graveled	N/A	0.10	0.10
	Bladed	0.75	0.075	0.10
Utility Lines	Water	N/A	0.35	----[1]
	Overhead Elec.	N/A	0.20	0.20
	Underground Elec.	N/A	0.35	----
Transportation Lines	Low Pres. Gas	N/A	0.90	----
	Intermediate Pres. Gas	N/A	0.25	----
Processing Area	Battery Site	N/A	0.020	0.020
	Access Roads	N/A	0.15	0.15
	Field Compressor	N/A	----	(0.5/24) = 0.02
	1/24 producing wells			
	Sales Compressor	N/A	----	(1.0/240) = 0.005
	1/10 Field Compressors			
	Plastic Line[2]	N/A	----	0.5
	Gathering Line	N/A	----	0.25
	Sales Line	N/A	----	0.075
Produced Water Management	Discharge Point	N/A	0.01	0.002
	Storage Impoundment	N/A	0.3	0.25
Total Disturbance		1.0	3.25	2.0

Note: This table shows levels of disturbance associated with exploration and development of CBNG wells and field transfer equipment. All values represent acres per well unless otherwise noted.

[1]All utilities are completed underground and the land above is reclaimed so the acres of disturbance are removed from the operation column. **Note:** The intent of reclamation is to stabilize the area of disturbance and establish a vegetative cover similar to the native plant community that existed prior to disturbance. Reclamation success will vary as described in the *Vegetation* section.

[2]Lines within processing area are assumed to disturb an average width of 25 feet.

Sales Compressors = 1 compressor per 240 producing wells or 10 field compressors

Plastic line = 0.5 mile per well pad. Assume 3 wells per pad, 25-foot width

Gathering line = 2.0 miles/field compressor at 25-foot width or (5280*2*25/24/43,560) = 0.25 acre/well

Sales line = 6.0 miles/sales compressor at 25-foot wide. (6*5280*25/240/43,560) = 0.075 acre/well

Produced Water Management

Assume 1 discharge point for every 20 wells

Discharge points construction = 0.01 acre/point based on 20-foot by 20-foot area during construction

Discharge points operations = 0.002 acre/point based on 10-foot by 10-foot area during operations

Storage impoundments = 6 acres/impoundment during construction per well pod of 20 wells, assume

one acre reclaimed from construction so 5 acres/impoundment during operation per POD of 20 wells

Total Area of Disturbance

Exploration = 1.0 acres/well

Construction = 3.25 acres/well

Operation = 2.0 acres/well

Field Rules and Leasing Stipulations

The discussion of impacts assumes the leasing stipulations described for each resource would be successfully implemented by each of the permitting agencies in each of the alternatives. Use of existing Lease Stipulations and mitigation measures (see Minerals Appendix, Table MIN-5) is considered to be standard operating procedures by BLM.

The MBOGC issues field rules that address the spacing of wells based on such factors as geology, technology and economics. The MBOGC will provide guidance to private landowners if requested on how and what to include in their leases to protect resources, but it is up to the individual lessor as to what they request from the operator in terms of reclamation, mitigation and other measures.

The Montana Trust Land Management Division (TLMD) of the Montana Department of Natural Resources and Conservation (DNRC) also has lease stipulations for their minerals as listed in the Minerals Appendix. The TLMD utilizes a set of standard stipulations on all oil and gas leases that is different from those used by BLM. Additional stipulations are placed on the leases on a case-by-case basis prior to their being leased. In addition, the TLMD undertakes a site-specific review process for exploration and operating plan proposals. This review process generates site-specific stipulations for issues such as steep topography, wildlife, streams, wooded areas and rivers and lakes. It was assumed that only requirements contained in existing federal and state law that apply to private land ownership will be enforced on private land.

Stipulations and field rules are intended to avoid potential effects on resource values and land uses from oil and gas activities and include actions such as site clearances and occupancy and timing restrictions.

Lease stipulations would be implemented before conducting exploration, production and abandonment activities. The following discussion of project impacts assumes applicable stipulations and field rules would be fully implemented and followed. The actual disturbance per well will be dependent on the actual site specific water management practices used.

success of these stipulations or field rules in avoiding covered impacts, in some instances, will require collection of site specific information regarding the resources to be protected relative to exploration, production and abandonment plans followed by strict adherence to the terms of the stipulations and field rules. Planned monitoring activities by the BLM for all resources have been outlined in a table attached in the Monitoring Appendix. Impacts described include those that would occur in spite of the successful implementation of stipulations or field rules, or where stipulations or field rules are not expected to avoid all impacts.

Proposed mitigation measures are intended to minimize the impacts that cannot be avoided. Mitigation measures also apply to all alternatives on BLM and state lands. Residual impacts are those expected to remain after the implementation of mitigation measures.

General Assumptions

Assumptions represent the best professional judgment of the specialist based on experience, similar occurrences and known circumstances and studies. Assumptions that are common to all of the alternatives provide the foundation for the analysis of impacts. The following assumptions apply to each alternative:

- The spacing for CBNG wells would be similar to CBNG well spacing in Wyoming with one well per 80 acres per coal seam. Up to five coal seams have been identified for possible methane extraction in the Powder River Basin. However, for analysis purposes, it is assumed that an average of three wells would be drilled per 80-acre spacing unit.

- The life of a typical CBNG production well is assumed to be 20 years, including construction and reclamation.

- CBNG wells will come on line and go off line as described in the RFD.

- Water production for a single CBNG well can be estimated by the following equation:

$$Q = 14.661e^{-0.0242t}$$

Where Q = discharge in gpm and t = time in months. The average production over 20 years using this equation is 2.5 gpm; however

discharge rates would begin at approximately 15 gpm and decrease over time as the coal seam becomes depressurized.

- The combination of the 2 preceding assumptions results in the maximum discharge for the total field occurring in year 6 of the development, for Alternatives B, C, D and E when 7,095 wells would be pumping at an average rate of 6.2 gpm to produce 43,989 gpm. This maximum produced water volume is used for the impact analysis.

- Under phased development for Alternative F, the maximum amount of water produced in the field would occur in year 12 when 10,081 wells would probably pump at an average rate of 3.5 gpm to produce 34,961 gpm. This maximum produced water volume is used for the impacts analysis for Alternative F.

- Under phased development for Alternative G, the maximum amount of water produced in the field would occur in year 12 when 3,577 wells would probably pump at an average rate of 3.5 gpm to produce 12,390 gpm. This maximum produced water volume is used for the impacts analysis for Alternative G.

- Under Alternative H, the maximum amount of water produced in the field would occur in year 16 when 13,403 wells would probably pump at an average rate of 2.9 gpm to produce 39,400 gpm. This maximum produced water volume is used for the impacts analysis for Alternative H.

- 20 percent of waters discharged will evaporate or infiltrate prior to reaching perennial waters.

- It is assumed that a single CBNG well will drain the methane from a single coal seam over an 80-acre unit. Research by the BLM in the Wyoming portion of the Powder River Basin suggests drainage may be across a broader radius (Crockett and Meyer 2001). Drainage issues will need to be assessed on a case-by-case basis to determine the drainage radius, which will depend upon local reservoir parameters.

- The level of disturbance associated with a production well is the same regardless of the method of completion, whether a single well bore per coal seam or multiple seam completions in a well bore.

- Typical drilling operations for each CBNG well, regardless of whether it was a CBNG exploration or production well, would require 3 to 5 days with an additional 2 to 3 days for completion work. A maximum of 7 to 8 people would be present on a well at any one time during this construction phase.

- Approximately 26,000 gallons of water would be needed to drill each well. The water will typically be obtained from other producing CBNG wells in the area, or trucked into remote sites as needed.

- Equipment present at each well site during construction would consist of the following: one or two truck-mounted drill rig(s), with three men per rig; one backhoe; one blade; three crew pick-up trucks; one well logging truck; one pipe truck; two to four water trucks; one cement truck; one electrical generator trailer; one frac tank for wastewater; and two large flat bed trailers. Not all vehicles would be at the well site at the same time or for the entire duration of drilling and completion operations.

- Portable toilets would be available at the drill sites. Garbage would be stored in closed containers. Sewage and solid waste would be hauled offsite to permitted disposal facilities.

- Each CBNG well would be equipped with a submersible pump ranging from 3 to 20 horsepower, depending on well depth, required pumping rate and other site conditions.

- Exploration wells would be visited once a day during testing and pumping operations. Pump tests could last as long as 6 months depending on the time required for measuring cumulative methane production estimates. Methane would be flared (burned off) continuously during the testing phase.

- Fuel for generators during exploration testing would be either gas (propane) or diesel and require at least one trip to the well site weekly. Small generators used during testing would be mobile, enclosed and between 15 to 20 kilowatts (kW).

- A larger generator used during production would serve several wells (three to four) and be in the range of 75 to 125 kW.

- The selected alternative (Alternative 2A) for water and that portion of Alternative 1 regarding the use of natural gas fired compressors for the Wyoming Powder River Basin oil and gas projects will be implemented under all

alternatives. This alternative assumes continued development of CBNG and conventional oil and gas resources would occur in the Wyoming Powder River Basin Planning Area. Up to 39,367 additional CBNG wells and 3,200 conventional oil and gas wells would be developed over the next 10 years.

- Under Alternatives B through H, the number of exploration/dry holes would be approximately 10 percent of the total estimated wells drilled.

- Under Alternatives B through E all exploration/dry holes would be drilled in the first 5 years of development. Under Alternatives F, G and H, exploration/dry holes would comprise approximately 10 percent of the wells drilled annually.

- Under Alternatives A and C, the number of wells connected to each compressor would be per operators plans; it is assumed that this is consistent with the RFD of 24 wells per compressor. This estimate is based on an average well production rate of 250,000 cubic feet per day methane being sent to a 6 million cubic feet per day, four-stage reciprocal compressor operating at 380 horsepower and using natural gas.

- Under Alternatives B, D, E, F, and G the number of wells connected to each compressor would be maximized; this is assumed to be approximately 35 wells at average production going to a 9 million cubic feet per day, four-stage reciprocal compressor. Under Alternative H, the number of wells connected to each field compressor reflects what is currently practiced by operators within the Montana portion of the PRB which is 40 wells per compressor. The maximization of well connections would reduce the number of field compressor sites and subsequently air emissions.

- No hydraulic fracturing or cavitation would be required to stimulate wells; however, low-pressure, low-volume water enhancement may be used. This would involve flushing the well with a few hundred gallons of water to clean the face of coal surface in the exposed seam. This process does not fracture the coal; it simply cleans out the existing fractures.

- Under Alternatives B and D in the theme of CBNG, multiple completions in a single borehole would be required. It is assumed that a small reduction in surface disturbance would be experienced, but that the levels of disturbance previously described are acceptable for these alternatives without alteration.

- Under Lands and Realty, when no transportation corridors are required, it is assumed the utility lines (power, water and gas) would be placed along separate routes, or in existing disturbances to and from the well site locations or compressor batteries, whichever is more suitable to the operator. When transportation corridors are required, it is assumed they would be placed adjacent to access roads and along existing disturbances, resulting in a 35 percent reduction of disturbed surface areas.

- Concerning Socioeconomics it is assumed the state would not enforce buffer zones on their minerals or on private minerals since they do not have a trust responsibility.

- The potential development on the reservations would be considered under the cumulative effects analysis based on the development outline in the RFD for the reservations.

- Under the Hydrology theme for Alternative B, untreated CBNG water from exploration wells would be placed in tanks and disposed of at a permitted injection well. It is assumed the use of pits, impoundments and other holding facilities as permitted under Alternative A would be allowed. In addition, it is assumed produced water would be injected into a deeper aquifer of lesser quality with no communication to aquifers used as sources of drinking water or into coal seam aquifers.

- Under the Hydrology theme for Alternatives C and D, produced water would be available for beneficial use. It is assumed industries and landowners would use approximately 20 percent of the produced water. The estimate of 20 percent is based on the observed beneficial uses at the CX Ranch and in Wyoming and on the perceived potential for similar uses throughout the Planning Area.

Assumption Rationale

CBNG Well Production Life

The rationale for using a 20-year lifespan for a typical CBNG well in Montana is based on several technical considerations as well as the best professional judgment of several specialists. The well life is based on the economic limit selected for the

well, the wide variety of geologic basins in Montana, the data limitations, the variations in the rank of coals that may be encountered in Montana and a review of the well life of CBNG wells in other producing basins, including Wyoming and the San Juan Basin. These rationales are generally summarized below:

Montana Planning Area: The Planning Area for the FSEIS for BLM is the Billings and Powder River RMPs. Although an emphasis was placed on the Powder River Basin, assumptions used were derived for the entire Planning Area based on existing available information. CBNG production in Montana and Wyoming is relatively new as compared to conventional oil and gas production in either of these states. In Montana, approximately 550 producing CBNG wells exist in the CX Ranch Field near Decker, Montana. Throughout Montana, very little information is available relative to CBNG production or testing outside of the current producing area at CX Ranch. Further, there are a variety of underground coal seams that must be considered, including areas in the Powder River Basin, Bull Mountain Basin and areas elsewhere in the state (including the entirety of the two BLM RMPs).

1. **Economic Production Limits on CBNG Wells**: The BLM in Wyoming selected an average production life for CBNG wells in the Planning Area based on production decline analysis from existing production on federal leases. These analyses assume an economic limit of approximately 1,000 thousand cubic feet (MCF) per month (personal communication, Bob Chase, BLM). CBNG producers currently operating in the Wyoming Powder River Basin suggested the economic limit of 1,000 MCF per month to the BLM. Based on Wyoming's limited planning area and the extent of existing data available that is directly within the Planning Area, this approach appears justified. To date, no wells have been confirmed as reaching their economic limit in the Powder River Basin in either Wyoming or Montana. Several wells have reached monthly production of less than 1,000 MCF per month and several other wells have been shut-in. However, based on existing knowledge of CBNG operations, it is not clear whether shut-in wells will remain shut-in without further production.

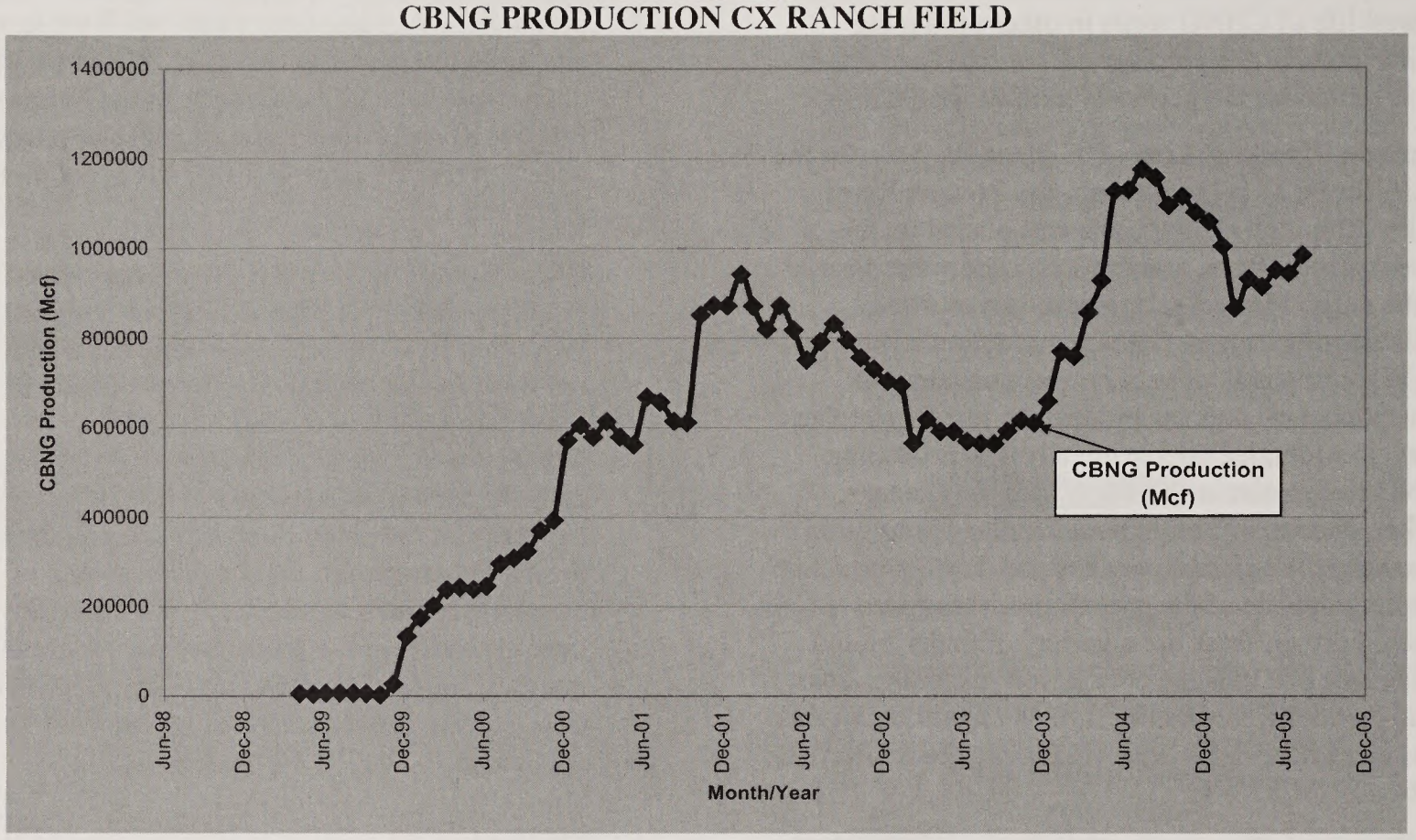
   The economic limits used by the Wyoming BLM of 1,000 MCF per month appear reasonable for planning in the Wyoming portion of the basin. However, there are many examples of wells producing at rates of less than 1,000 MCF per month for considerable periods. The Wyoming portion of the Powder River Basin has production rates less than 1,000 MCF while continuing to produce. However, it is currently unknown whether CBNG wells in the Montana Powder River Basin will be shut-in and plugged once a production rate of 1,000 MCF per month is achieved.

   Of further consideration is the rationale that the proposed economic production limit used in the Wyoming EIS is based on certain economics provided by operators currently producing in Wyoming. Many of these producers are relatively large businesses. In the case of conventional oil and gas production, it is common for larger producers to sell production to smaller companies that may be capable of operating projects at a lesser cost—especially later in the life of the project when production rates are substantially reduced. This progression of producing properties transitioning from large companies to smaller companies supports the argument that the viable economic production life of a CBNG well could be less than 1,000 MCF per month. This is especially significant considering the socioeconomic situation in Montana and especially relative to the Northern Cheyenne and Crow reservations.

2. **Geologic Differences**: Because the Montana Planning Area includes the entire state, there are significant differences in geology when comparing assumptions used for impact analyses between the two plans.

3. **Data Limitations**: CBNG production in Montana and Wyoming is relatively new as compared to conventional oil and gas production in either of these states. In Montana, approximately 550 producing CBNG wells exist in an area near Decker, Montana. Throughout Montana, little information is available relative to CBNG production or testing outside of one current producing area at CX Ranch. Further, there are a variety of underground coal seams that must be considered, including areas in the Powder River Basin, Bull Mountain Basin and areas elsewhere in the state (including the entirety of the two BLM RMP areas). Figure 4-3 presents production data for the CX Ranch field near Decker, Montana (MBOGC 2005). This figure shows that actual production of CBNG in Montana started in April 1999.

FIGURE 4-3
CBNG PRODUCTION CX RANCH FIELD



4. **Variations in Rank of Coal**: Coals in the Powder River Basin are all of Tertiary age throughout both Montana and Wyoming. However, the Montana Planning Area includes coals that are much older and of higher rank. For instance, the coal seams near Bozeman Pass and Great Falls are of Cretaceous age and have an overall higher rank than Powder River Basin coals. This suggests that these coals may contain methane that is more thermogenic in nature than biogenic. Although there is not any existing production data for areas other than the CX Ranch in Montana, it is reasonable to assume that CBNG wells in these areas may produce economic quantities of methane for longer durations than in the Powder River Basin without the benefit of historical production data. In certain situations, where multiple coal beds are present, a well's productive life can be extended by reworking the well to produce gas from deeper coal beds. For example, well completions in multiple coal beds could extend the life of a well site by 10 to 30 years.

Studies of CBNG wells in the San Juan Basin, which produce from greater depths than CBNG wells in the PRB, have projected CBNG gas production for 20 years. The deeper coal in other basins of Montana may produce in a similar fashion and have a well life of 20 years.

Differences in Produced Water Sodium Absorption Rate (SAR) and Electrical Conductivity (EC) Values

These differences are based on differences that exist across the basin. These differences are based on geologic and the available produced water data for each state. The geologic differences relate to how the coal seams change northward across the basin. In Wyoming, the coals seams are thicker (averaging up to 250 feet or more in aggregate thickness in many areas) and more continuous, northward in the basin into Montana, the coal seams thin (generally less than 100 aggregate feet) and become locally discontinuous.

In Montana there is a limited data set with little data outside the CX Ranch, which was used as the basis for the SAR and EC values in the DEIS. The produced water data available for the Montana Powder River Basin indicates there are significant differences in water quality in the northern part of the basin in comparison to the Wyoming portion of the Powder River Basin. The water quality data available for Montana varies enough from Wyoming that using the Wyoming data for impact analysis in Montana would underestimate the potential impacts in Montana.

Maximum Drawdown in Coal-Seam Aquifers

The Montana Bureau of Mines and Geology (Wheaton and Metesh 2002) released a report on the potential groundwater drawdown and recovery in the Montana portion of the Powder River Basin. The results of this report indicate that drawdown within the coal seams could be as high as 240 to 600 feet within the well field. The report also indicated drawdown as high as 300 feet in the interburden units and 6 feet in the overburden units. The results of the model showed drawdown up to 30 feet at a distance of approximately two miles from the well field and drawdown of five feet at a distance of approximately seven miles. The results of this model have been used for the impact analysis in this document.

Decrease Flow in Surface Water

In the Montana portion of the Powder River Basin, the bulk of the coals of the Fort Union Formation are confined to the Tongue River Member, while the Lebo and Tullock Members are predominantly shale and shaley sand (McLellan et al. 1990). Because of the confined nature of the coals and lack of the Wasatch Formation in Montana, the production of CBNG water is not expected to result in decreases to surface water base flows. There are also several potential increases to flow that may mask any potential decreases in surface water flow. The discharge of CBNG-produced water to the ground surface and surface waters would mask any reduction in flow in the surface waters.

Beneficial Use of CBNG Production Water

The Montana EIS preparation team assumes 20 percent of the produced water will be available for beneficial purposes in Alternatives C and D. Under Alternatives E, F, G and H it is assumed that emphasizing beneficial uses combined with increased flexibility for water management practices should result in an increase in beneficial water usage. The beneficial uses envisioned are based on current practices, such as livestock watering, creation of wildlife watering areas (Environmental News Network 2001), coal mine dust suppression (Fidelity 2001), irrigation, constructed wetlands (Davis 1995), domestic water supply, produced water as drilling fluid (Clark and Hemler 1992), de-icing of road aggregate storage piles (DeWalle and Geleone 1990) and enhancement of fisheries and riparian zones (Wyoming Game and Fish Department, n.d.).

Wyoming RFD Impacts

The Montana EIS accounts for the full scale of development proposed by the current Wyoming RFD (which has since been adopted). In the Minerals Appendix an expanded discussion regarding both the Wyodak RFD of 6,000 wells and the current Wyoming RFD with a proposed new 39,400 wells is addressed. Furthermore, within the *Hydrology and Air* sections of Chapter 4 under the *Conclusions for Alternative A* the effects of the expanded Wyoming RFD is acknowledged and accounted for in the impact analysis. These conclusions are also referenced under the other alternatives conclusion sections for cumulative impacts because they address the full range of possible impacts from Wyoming CBNG development.

Resource Topics

Air Quality and Climate

Air Quality

Existing air quality throughout most of the analysis area is in attainment with all ambient air quality standards. However, three areas have been designated as federal nonattainment areas where the applicable standards have been exceeded in the past: Lame Deer (PM_{10}—moderate) and Laurel (SO_2—primary), Montana; and Sheridan, Wyoming (PM_{10}—moderate).

Air emission impacts based on modeling show potential impacts only. Potential impacts would be mitigated through project level permitting by federal, state, or tribal regulatory agencies.

Alternatives A, B and D were modeled in the 2003 Final Statewide EIS based upon the modeling domain and receptor grids used in the Technical Support Document (Argonne 2002). Alternatives C and E were not modeled, as their emission sources were essentially the same as for Alternative B. Alternatives E, F and H were subsequently modeled for this FSEIS by using an updated grid system, which expanded the near-field receptor grid; an updated meteorological base year (2002); updated emission sources to the most currently available data (2004); and updating RFFAs to include the TRR. Alternative G was not modeled, but would represent emission levels of approximately 65 percent of Alternative F due to only 65 percent of CBNG wells being completed in this scenario. Additionally, CO was not modeled for Alternatives E, F and H in the FSEIS, as initial modeling conducted in the 2003 Oil and Gas EIS showed impacts were quite small in relation to existing applicable air quality standards.

In 2007, BLM prepared a Supplemental Air Quality Analysis to assess the level of CBNG development that would require mitigation to reduce the potential for impacts to air quality. The Supplemental Air Quality Analysis provides additional information and analyses regarding the level of CBNG development that would have the potential to impact air quality within the Powder River and Billings RMP areas. It includes an analysis and comparison of the potential for CBNG development to impact air quality under different air quality emission rates under the preferred alternative (Alternative H). The information contained within the Supplemental Air Quality Analysis is intended to expand on the air quality information presented in the DSEIS and the Air Quality Technical Support Document (revised October 2007).

Alternative A
No Action (Existing CBNG Management)

- Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.
- Maximum concentrations would be below applicable state and National Ambient Air Quality Standards and PSD increments for near-field and far-field modeling.
- Potential direct impact on visibility within one mandatory federal PSD Class I, one Class II Area and the Class II Crow Reservation.
- Cumulative Impacts:
  - Potentially exceed the 24-hour PM_{10} NAAQS and PSD Class II increments south of Spring Creek Mine.
  - Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation.
  - Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area.
  - Potential visibility impacts in 10 of 17 federal PSD Class I including the Crow and Fort Peck reservations. Additional visibility impacts to 7 of 13 PSD Class II sensitive areas including the Crow and Fort Belknap reservations.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.
- Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.
- Potential direct visibility impacts within seven mandatory federal PSD Class I Areas and the Northern Cheyenne Reservation. Additional visibility impacts to seven federal PSD Class II areas including the Crow and Fort Belknap Reservations and three Wilderness Areas and one National Recreation Area and one National Monument.
- Cumulative Impacts:
  - Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$ NAAQS south of Spring Creek Mine.
  - Potentially exceed the PSD Class II increments for 24-hour PM10 south of Spring Creek Mine.
  - Potentially exceed PSD Class I increments for 24-hour PM_{10} on the Northern Cheyenne Reservation and Washakie WSA.
  - Potentially exceed PSD Class I increments for annual NO_2 on the Northern Cheyenne Reservation.
  - Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area and Florence Lake in the Class II Cloud Peak Wilderness Area.
  - Potential visibility impacts in all federal PSD Class I and II sensitive areas including the Northern Cheyenne, Fort Peck, Fort Belknap and Crow reservations.

Alternative C
Emphasize CBNG Development

- Impacts under Alternative C are expected to be comparable to those describe for Alternative B but somewhat increased in severity due to the lack of control over operators choice of compressor fuel, reduced limits on compressor hook ups and the lack of enforceable control measures.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Localized short-term increases in CO, NO_x, SO_2, $PM_{2.5}$ and PM_{10} concentrations.
- Maximum concentrations are expected to be below applicable state and NAAQS and PSD increments for near-field and far-field modeling.
- Potential direct visibility impacts within one mandatory federal PSD Class I Areas. Additional visibility impacts to three PSD Class II areas including the Crow Reservation, one Wilderness Area and one National Recreation Area.
- Cumulative Impacts:
  - Potentially exceed the 24-hour PM_{10} and $PM_{2.5}$

NAAQS south of Spring Creek Mine. – Potentially exceed the PSD Class II increments for 24-hour PM_{10} south of Spring Creek Mine. – Potentially exceed PSD Class I inerements for 24-hour PM_{10} on the Northern Cheyenne Reservation and Washakie WSA.
– Potentially exceed atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area. – Potential visibility impacts in 14 of 17 federal PSD Class I and all Class II sensitive areas ineluding the Northern Cheyenne, Fort Peck, Fort Belknap and Crow reservations.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts while Maintaining Existing Land Uses**
• Impacts modeled for Alternative E would consist of the potential for localized short-term increases in NO_x, SO_2, PM_{10} and $PM_{2.5}$ concentrations. • Maximum concentrations resulting from project-related activities are expected to be below applicable state and NAAQS and PSD increments. • Alternative E would not result in a change in acid neutralizing capacity above significance thresholds for any Class I areas in the modeling domain. • Visibility impacts above 1.0 dv would occur in 7 to 10 PSD Class I areas and 6 to 12 PSD Class II Areas. • Given the non-project emission sources located throughout the analysis region, there would be a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative E. However, none of the predicted impacts exceeds state or NAAQS. • The air-quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.
Alternative F **Phased Development Multiple Screens (High Range)**
• Impacts under Alternative F would be comparable to those described for Alternative E, but would be fewer and would level off over time due to the 5 percent annual limit for applications for permit to drill (APDs) approved on BLM-administered surface. • Cumulative impacts under Alternative F would be the same as for Alternative E. • The air quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.
Alternative G **Low-range, Phased CBNG Development**
• Impacts under Alternative G would be fewer than for Alternatives E or F due to a lower number of wells predicted to be drilled. This would result in a reduction of approximately 65 percent in the number of compressors that would be required. Fewer well pads and roads would also have to be constructed. • Cumulative impacts under Alternative G would be fewer than for Alternatives E or F due to 65 percent less wells predicted to be drilled. This would result in construction of approximately 65 percent fewer compressors, well pads and roads. • The air quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts under Alternatives H would be less than those described for Alternative E due to the implementation of the air quality screen for CBNG development. • Cumulative impacts under Alternatives H would be less than those described for Alternative E due to the implementation of the air quality screen for CBNG development. • The air quality permitting process would be used to analyze emission sources at the project level. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

ASSUMPTIONS

Potential air quality impacts for Alternatives A, B and D were evaluated using the air quality model conducted for the 2003 Montana Statewide Final Oil and Gas Environmental Impact Statement and Proposed Amendment of the Powder River and Billings Resource Management Plans (Statewide Document) (Argonne 2002). Alternatives C and E were not modeled for the Statewide Document, as their emission sources were essentially the same as for Alternative B. Those data and the impact analysis based on that modeling effort are retained in this FSEIS. Alternatives E, F and H were subsequently modeled for this FSEIS using an updated receptor grid system (which expanded the near-field receptor grid), an updated meteorological base year (2002), updated emission sources to the most currently available data (2004) and updating the reasonably foreseeable future actions (RFFAs) to include the TRR. Alternative G was not modeled, but would represent potential emission impacts at approximately 65 percent of Alternative F due to that percent fewer CBNG wells being completed under Alternative G compared to Alternative F.

Three groups of emission sources contribute to the modeled emission results. They are existing emissions, CBNG project-related emissions and RFFA emissions. Existing emissions consist of emissions from those sources that currently exist for the baseline year of 2004. Existing emission data were obtained from the appropriate state regulatory agencies as well as the Western Regional Air Project (WRAP) database. CBNG project-related emissions were developed on the basis of the RFD scenario outlined in the Minerals Appendix and modified for

elements specific to each alternative. CBNG project-related emissions were further broken down into emissions that result from construction activities and emissions that result from operations and maintenance activities. RFFA emissions consist of those that would result from projects or facilities not currently operating, but reasonably expected to operate sometime during CBNG development. Examples of RFFA emission sources would be the TRR or the Roundup Power Plant.

The modeling methodology and detailed results for the model conducted for this FSEIS are contained within the Air Quality Appendix. A summary of the results is found in the impact analyses for Alternatives E, F and H, as well as a discussion of potential impacts for Alternative G.

Although the CBNG development (project sources) and non-project sources emit carbon dioxide and methane, climate impacts are anticipated to be small from implementation of any of the alternatives. Climate impacts may even be beneficial to the extent that:

- Development of the CBNG resource reduces the natural emissions of methane from coal mines
- Use of CBNG displaces combustion of coal or oil, both of which emit more carbon dioxide than methane per unit energy produced.

Carbon monoxide (CO) was not modeled for Alternatives E, F and H in the FSEIS, as initial modeling conducted in the Statewide Document (Argonne 2002) showed impacts were quite limited relative to existing applicable air quality standards.

The potential for ozone formation due to project-related sources was not included as part of the FSEIS modeling effort. The decision to not include ozone within the modeled constituents was based on results predicted in previous modeling efforts conducted for the Coal Study (ENSR 2005a, 2005b) and the 2003 Oil and Gas EIS (Argonne 2002). These modeling efforts indicated that primary pollutants (oxides of nitrogen [NO_x]), CO and non-methane volatile organic compounds (VOCs), which are known to be precursors required for the formation of ozone, would not be produced from project-related sources at levels that would contribute to ambient ground level ozone concentrations to any measurable extent.

With respect to analysis of prevention of significant deterioration (PSD) increments, a regulatory PSD increment analysis has to include all historic emission changes since the PSD trigger date, which extends back to 1978 for the area around Colstrip. Both increment expansion and consumption have taken place since that date. An analysis of this sort is beyond the scope of this project. The Montana Department of Environmental Quality (MDEQ), in cooperation with the Northern Cheyenne Tribe and the Environmental Protection Agency (EPA), is conducting this type of analysis. The results will be factored into the new source review process in permitting additional CBNG sources in the study area.

Potential impacts to air quality are summarized in this section. A more complete summary of the modeled potential air quality impacts for Alternatives A thru D are given in the Air Quality Appendix - Part 1 with a highly detailed description of the air quality modeling given in Argonne 2002. The Air Quality Appendix—Part 2 for this FSEIS—includes a detailed description of the methodology and results of the air quality modeling conducted for this FSEIS for Alternatives E, F and H.

Issues, Impact Types and Criteria

Fugitive dust and exhaust from construction activities, along with air pollutants emitted during operation (e.g. well operations, field and sales compressor engines), are potential causes of air quality impacts. These issues are more likely to generate public concern where natural gas development activities occur near residential areas. The Federal Land Managers (FLM), including the U.S. Department of Agriculture (USDA), USFS; the U.S. Department of Interior (USDI), National Park Service (NPS); and the USDI, U.S. Fish & Wildlife Service (FWS), have also expressed concerns regarding potential atmospheric deposition and visibility impacts within PSD Class I and PSD Class II areas under their administration, located throughout Montana, Wyoming, southwestern North Dakota, western South Dakota, northwestern Nebraska and southeastern Idaho.

Air pollution impacts are limited by local, state, tribal and federal air quality regulations, standards and implementation plans established under the Clean Air Act (CAA) and administered by the MDEQ—Air Resources Management Bureau and the EPA. Although not applicable to the proposed Alternatives, the Wyoming Department of Environmental Quality—Air Quality Division (WYDEQ) has similar jurisdiction over potential air pollutant emission sources in Wyoming, which can have a cumulative impact with MDEQ approved sources. Air quality regulations require certain proposed new, or modified existing, air pollutant emission sources (including CBNG compression facilities) to undergo a permitting review before their construction can begin.

Therefore, the applicable air quality regulatory agencies have the primary authority and responsibility to review permit applications and to require emission permits, fees and control devices, prior to construction and/or operation.

In addition, the U.S. Congress (through the CAA Section 116) authorized local, state and tribal air quality regulatory agencies to establish air pollution control requirements more (but not less) stringent than federal requirements. Site-specific air quality analysis would be performed and additional emission control measures, including a best available control technology (BACT) analysis and determination, may be required by the applicable air quality regulatory agencies to ensure protection of air quality resources. Also, for resources discussed in this SEIS, the BLM will not authorize any activity that does not conform to all applicable local, state, tribal and federal air quality laws, regulations, standards and implementation plans.

The significance criteria for potential air quality impacts include local, state, tribal and federally enforced legal requirements to ensure air pollutant concentrations would remain within specific allowable levels. These requirements include the National and Montana Ambient Air Quality Standards, which set maximum limits for several air pollutants and PSD increments, which limit the incremental increase of NO_2, sulfur dioxide (SO_2) and particulate matter less than 10 microns in diameter (PM_{10}) concentrations above legally defined baseline levels. These legal limits were presented in Chapter 3. Where legal limits have not been established, the BLM uses the best available scientific information to identify thresholds of significant adverse impacts. Thresholds have been identified for hazardous air pollutant (HAP) exposure, potential atmospheric deposition impacts to sensitive lake water chemistry and a "just noticeable change" in potential visibility impacts.

An extensive air quality modeling technical support document was prepared by Argonne National Laboratory (Argonne 2002) and is summarized in the Air Quality Modeling Appendix of the Statewide Document (BLM 2003). This technical report is available for review (contact information is given in the Air Quality Appendix – Part 1). Argonne modeled potential changes in air quality from individual Alternatives A, B, C, D and E, non-project emission sources and all sources cumulatively by alternative. Since Alternatives B, C and E have similar emission inventories, a single air quality analysis represents all three alternatives.

An Air Quality Model Technical Support Document (AQTSD, revised October 2007) and a Supplemental Air Quality Analysis (SAQA) report were also prepared for the modeling effort conducted for this FSEIS. These documents are available for review on the FSEIS project website at http://www.blm.gov/eis/mt/milescity_seis/.

The air quality modeling was based on the best available engineering data and assumptions, meteorology data and dispersion modeling procedures, as well as professional and scientific judgment.

Due to the regional nature of this analysis, it should be considered a reasonable estimate of predicted impacts. Actual impacts at the time of project level development (subject to air pollutant emission source permitting) are likely to be less.

The EPA CALPUFF dispersion model was used with meteorological data generated by the MM5 (mesoscale model) and CALMET models. Meteorological information was assembled to characterize atmospheric transport and dispersion from several 1996 data sources, including the following:

1) 36 km gridded MM5 (mesoscale model) values with continuous four-dimensional data assimilation
2) Hourly surface observations (wind speed, wind direction, temperature, cloud cover, ceiling height, surface pressure, relative humidity and precipitation)
3) Twice-daily upper air vertical profiles (wind speed, wind direction, temperature and pressure)
4) PRISM-adjusted hourly precipitation measurements

Potential air pollutant emissions from the alternatives' emission sources (denoted as project sources) were calculated separately to determine potential impacts. These emissions were then combined with existing sources, proposed non-Powder River Basin oil and gas developments, RFFA emissions (denoted as non-project sources) and RFFA emissions from potential CBNG development on the Northern Cheyenne and Crow reservations and the Ashland District of the Custer National Forest to determine the total potential cumulative air quality impacts. All of the tables in this analysis and the Air Quality Appendix display modeled emissions from the following:

1) The project sources only
2) The project sources combined with emissions from potential CBNG development on the Northern Cheyenne and Crow reservations and the Ashland District of the Custer National Forest (denoted as "Project + RFFA Sources)

3) The non-project sources

4) Cumulative totals

The non-project sources include development permitted by the following agencies and states: 1) MDEQ; 2) WYDEQ; and 3) within the states of North Dakota, South Dakota and Nebraska; and projections for the Wyoming Powder River Basin Oil and Gas Project DEIS Alternative sources (BLM 2002a); and other RFFA sources from states within the geographic area covered by the model. Table 4-7 shows total emissions from the non-project permitted and other RFFA sources, Wyoming Powder River Basin oil and gas project sources and Montana Powder River Basin oil and gas project sources, combined with RFFA sources. These emissions are for Alternatives B, C and E; Alternative A and D emissions would be lower and potential CBNG wells on the Northern Cheyenne and Crow reservations and the Ashland District of the Custer National Forest have been included with emissions for Alternatives B, C and E.

The meteorology data and air pollutant emission values were combined to predict maximum potential direct, indirect and cumulative near-field air quality impacts in the vicinity of assumed well and compressor engine emission sources for comparison with applicable air quality standards and PSD Class II increments. Maximum potential near-field particulate matter emissions from traffic on unpaved roads and during well pad and compressor station construction were used to predict the maximum annual and 24-hour average SO_2, particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) and PM_{10} impacts. Maximum air pollutant emissions from each CBNG well would be temporary (i.e., occurring during a 12-day construction period) and would occur in isolation, without significantly interacting with adjacent well locations. Particulate matter emissions from well pad, compressor station and resource road construction would be minimized by application of water and/or chemical dust suppressants. The control efficiency of these dust suppressants was estimated at 50 percent during construction. During well completion testing, natural gas could be burned (flared) on a single day.

Air pollutant dispersion modeling was also performed to quantify potential particulate matter, CO, NO_2 and HAP impacts during operation. Operation emissions would primarily occur due to

TABLE 4-7

NON-PROJECT AND PROJECT TOTAL EMISSIONS SUMMARY

Source Category	Annual Emissions (tons/year)					
	NO_x	SO_2	PM_{10}	$PM_{2.5}$	CO	VOCs
Non-Project Sources (2006)						
DM&E Sources	14,391	3,655	722	263	799	294
CDWII Sources	1,269	563	257	---	---	---
Wyoming Sources	7,250	1,773	2,691	1,028	13,505	2,795
Montana Sources	3,169	950	2,279	1,003	2,576	880
Nebraska & North Dakota Sources	1,114	26	102	48	449	132
New Sources Subtotal	27,192	6,966	6,051	2,343	17,329	4,101
Montana RFFA Sources	2,844	4,796	127	71	6,171	20
Wyoming RFFA Sources	1,578	3,381	298	155	3,381	--
South Dakota RFFA Sources	289	35	53	53	175	71
Other RFFA Sources Subtotal	4,710	8,212	478	279	9,277	91
Wyoming Alternative 1 Project Sources (w/Project Year noted)	**17,834** (Yr 5)	**829** (Yr 3)	**2,918** (Yr 6)	**1,280** (Yr 5)	**14,799** (Yr 5)	**8,268** (Yr 5)
Total Non-Project Sources	**49,737**	**16,007**	**9,447**	**3,902**	**41,855**	**12.460**
Montana Alt. B, C and E Project + RFFA Sources (w/Project Year noted)	**9,959** (Yr 18)	**339** (Yr 5)	**1,230** (Yr 5)	**514** (Yr 15)	**9,378** (Yr 20)	**4,841** (Yr 20)

DM&E – Dakota, Minnesota and Eastern Railway Corporation

CDWII – Continental Divide/Wamsutter II and South Baggs Natural Gas Development Projects

increased compression requirements, including field and sales compressor stations. Since produced natural gas is nearly pure methane and ethane, with little or no liquid hydrocarbons, direct VOC emissions are not likely. HAP impacts were predicted based on an assumed, six-unit, 1,650-horsepower each, reciprocating compressor engine station operating at full load with emissions generated by a single stack.

The EPA CALPUFF dispersion model was also used to determine maximum far-field ambient air quality impacts at downwind mandatory federal PSD Class I areas and other sensitive receptors, to accomplish the following:

1) Determine if the PSD Class I increments might be exceeded

2) Calculate potential total sulfur and nitrogen deposition and their related potential impacts to sensitive lakes

3) Predict potential visibility impacts (regional haze) within distant sensitive receptors

The National Environmental Policy Act (NEPA) analysis compares potential air quality impacts from the proposed alternatives to applicable ambient air quality standards and PSD increments, but comparisons to the PSD Class I and II increments are intended to evaluate a threshold of concern for potential impacts and do not represent a regulatory PSD Increment Consumption Analysis. Even though most of the development activities would occur within areas designated PSD Class II, the potential impacts on regional Class I areas are to be evaluated. The MDEQ will perform the required regulatory PSD increment analysis during the new sources review process. This formal regulatory process will include analysis of impacts on Class I and II air quality areas by existing and proposed emission sources. The activities are not allowed to cause incremental effects greater than the stringent Class I thresholds to occur inside any PSD Class I Area. Stringent emission controls (BACT – Best Available Control Technology) and emission limits may be stipulated in air quality permits as a result of this review, or a permit could be denied.

Several lakes within five USFS-designated wilderness areas were identified as being sensitive to atmospheric deposition and for which the most recent and complete data have been collected. The USFS (Fox et al, 1989) has identified the following total deposition (wet plus dry) thresholds below which no adverse impacts to air-quality related values (AQRVs) are likely: 5 kilograms per hectare per year (kg/ha-yr) for sulfur and 3 kg/ha-yr for nitrogen. The USFS Rocky Mountain Region has also developed a screening method (U.S. Department of Agriculture Forest Service - USFS 2000) which identifies the following Limit of Acceptable Change regarding potential changes in lake chemistry: no more than a 10 percent change in acid neutralizing capacity (ANC) for those water bodies where the existing ANC is at or above 25 microequivalents per liter (μeq/l) and no more than a 1 μeq/l change for those extremely sensitive water bodies where the existing ANC is below 25 microequivalents per liter (μeq/l). No sensitive lakes were identified by either the NPS or FWS.

Since the proposed Alternative and cumulative air pollutant emission sources constitute many small sources spread out over a very large area, discrete visible plumes are not likely to impact the distant sensitive areas, but the potential for cumulative visibility impacts (increased regional haze) is a concern. Regional haze degradation is caused by fine particles and gases scattering and absorbing light.

Potential changes to regional haze are calculated in terms of number of days with greater than a perceptible "just noticeable change" (1.0 deciview, or dv) in visibility when compared to background conditions. A 1.0 dv change is considered potentially significant in mandatory federal PSD Class I areas as described in the EPA Regional Haze Regulations (40 CFR 51.300 *et seq.*) and originally presented in Pitchford and Malm (1994). A 1.0 dv change is defined as about a 10 percent change in the extinction coefficient (corresponding to a 2 to 5 percent change in contrast, for a black target against a clear sky, at the most optically sensitive distance from an observer). This is a small but noticeable change in haziness under most circumstances when viewing scenes in mandatory federal Class I areas. However, the perceptibility threshold can be smaller or larger than this value depending on viewing conditions.

For example, a 1.0 dv change is not a "just noticeable change" in all cases for all scenes. Visibility changes less than 1.0 dv are likely to be perceptible in some cases, especially where the scene being viewed is highly sensitive to small amounts of pollution, such as a site with preferential forward light scattering. Under other view-specific conditions, such as where the sight path to a scenic feature is less than the maximum visual range, a change greater than 1.0 dv might be required to be a "just noticeable change."

This NEPA analysis is not designed to be a regulatory analysis conducted to Federal Land Manager (FLM) specifications nor is the analysis designed to predict specific visibility impacts for specific views in specific mandatory federal PSD Class I areas based on specific project designs. Rather, it is to characterize reasonably foreseeable visibility conditions that are representative of a fairly

broad geographic region, based on multiple assumptions regarding project and non-project source emissions. This approach is consistent with both the nature of regional haze and the requirements of NEPA. The modeling was conducted to identify areas that may require more detailed consideration when specific project-level permits are issued for CBNG development. At the time of a preconstruction air quality permit application, the applicable air quality regulatory agency may require a much more detailed visibility impact analysis. Factors such as the magnitude of dv change, frequency, time of the year and the meteorological conditions during times when predicted visibility impacts are above the 1.0 dv threshold should all be considered when identifying areas for scrutinizing at the project-permitting level.

The USFS, NPS and FWS have published their Final FLAG Phase I Report (Federal Register, Vol. 66 No. 2, dated January 3, 2001), providing a consistent and predictable process for assessing the impacts of new and existing sources on AQRVs including visibility. For example, the FLAG report states, "A cumulative effects analysis of new growth (defined as all PSD increment-consuming sources) on visibility impairment should be performed," and further, "If the visibility impairment from the proposed action, in combination with cumulative new source growth, is less than a change in extinction of 10 percent [1.0 dv] for all time periods, the FLMs will not likely object to the proposed action."

Air Quality Modeling Assumptions: Near-field impacts refer to receptor points less than 50 km (31.25 miles) from the emissions source; far-field impacts are greater than 50 km from the source. When reviewing the modeled near- and far-field results, it is important to understand the assumptions made regarding potential resource development. In developing this analysis, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used and specific locations) and so actual impacts may vary from the modeled values and would be affected by project permit conditions or stipulations. The modeling was based on the following assumptions:

- Total predicted short-term air pollutant concentrations were assumed to be the sum of the assumed background concentration, plus the predicted maximum cumulative modeled concentrations (for comparison to national and state AAQS; background concentrations are not added to modeled concentrations for comparison to PSD increments), which may occur under different meteorological conditions.
- Background air pollution concentrations were assumed to occur throughout the 20-year life of project at all locations in the region; even though this background was derived from monitoring primarily conducted in urban or industrial areas, rather than rural areas. The uniform background PM_{10} levels for each state are assumed to be representative of the background conditions for the entire modeled area of the PRB, based on monitoring data gathered throughout northeastern Wyoming and southeastern Montana.
- The maximum predicted air quality impacts occur only in the vicinity of the anticipated emission sources. Actual impacts would likely be less at distances beyond the predicted points of maximum impact.
- All emission sources were assumed to operate at their reasonably foreseeable maximum emission rates simultaneously throughout the life of project. Given the number of sources included in this analysis, the probability of such a scenario actually occurring over an entire year is very small.
- In developing the emissions inventory and model, there is uncertainty regarding ultimate development (i.e., number of wells, equipment to be used, specific locations, etc.) Most (90 percent) proposed CBNG wells and 30 percent of conventional wells were assumed to be fully operational and remain operating (no shut-ins) throughout the life of project.
- The total proposed booster (field) and pipeline (sales) compression engines were assumed to operate at their rated capacities continuously throughout the life of project (no phased increases or reductions). In actual developments, compression equipment is expected to be added or removed incrementally as required by the well field operation, compressor engines would operate below full horsepower ratings and all compressor stations would not be operating at maximum levels simultaneously.
- The HAP analyses assumed a 9,900 horsepower, six-unit, reciprocating compressor engine station would operate at full load and at maximum emission levels continuously throughout the life of project.
- The emissions inventory and model use peak years of construction and peak years of operations, which would not occur throughout the entire development region at the same time.

However, these conditions may occur in some areas.

- The emissions inventory and model assumed that an emission rate for compressor engines of 1.5 grams per brake horsepower-hour (b/bhp-hr) of NO_x. Since BACT is decided on a case-by-case basis, actual emission rates could be decided to be less or more than this level by the Departments of Environmental Quality in Wyoming or Montana and on Indian lands by EPA, for field and sales compressor engines. Actual NO_x emission rates may range from 0.7 to 2 b/bhp-hr.
- There are no applicable local, state, tribal or federal acid deposition standards. In the absence of applicable standards, the acid deposition analysis assumed that a "limit of acceptable change" is: a 10 percent change in ANC for lakes with a background ANC greater than 25 µeq/l; or a 1 µeq/l change in ANC for lakes with a background ANC less than 25 µeq/l and would be a reasonably foreseeable significant adverse impact. Further, the atmospheric deposition impact analysis assumed no other ecosystem components would affect lake chemistry for a full year (assuming no chemical buffering due to interaction with vegetation or soil materials).
- The visibility impact analysis assumed that a 1.0 dv "just noticeable change" would be a reasonably foreseeable significant adverse impact, although there are no applicable local, state, tribal or federal regulatory visibility standards. However, some FLMs are using 0.5 dv as a screening threshold for significance.
- Mitigation measures are included in the emissions inventory and model that may not be achievable in all circumstances. However, actual mitigation decided by the developers and local and state authorities may be greater or less than those assumed in the analysis. For example, maintaining a construction road speed limit of 15 mph may be reasonable in a construction zone but difficult to enforce elsewhere. Full (100 percent) mitigation of fugitive dust from disturbed lands may not be achievable. Further, 50 percent reduction in fugitive emissions is assumed based on construction road wetting on the unimproved access road to the pad and at the pad, but this level of effectiveness is characterized as the maximum possible. In the air quality modeling, no specific road wetting or other emissions were assumed to be used during the operations phase of the development (e.g., for maintenance vehicle traffic). However, during the review of proposed projects (applications for permit to drill [APDs]) the BLM would require specific mitigation measures in certain areas during the operational phase of development.
- Induced or secondary growth related to increases in vehicle miles traveled (believed to be on the order of 10 percent overall) is not included in the emissions inventory and model. Not all fugitive dust emissions (including county and other collector roads) have been included in the emissions inventory and model.
- Fugitive dust emissions from roads are treated as area sources rather than line sources in the model, which may thereby reduce or increase the predicted ambient concentrations at maximum concentration receptor points near the source, depending on the inputs to the model (e.g. meteorology, terrain). By not placing modeled receptors close to emission sources (e.g. wells and roads), the model may not capture higher ambient concentrations near these sources. A more refined, regulatory model may yield higher concentrations at locations near fugitive dust sources.
- For comparisons to the PSD Class I and II increments, the emissions inventory and model included only CBNG and reasonably forseeable future actions (RFFA) sources. Other existing increment consuming sources such as Campbell County coal mines were not included in this comparison, as the focus of the air quality analysis is on the proposed project and alternatives, and does not represent a regulatory PSD increment consumption analysis. A regulatory PSD increment consumption analysis needs to identify and consider all PSD increment consuming sources to determine the level of PSD Class II increment consumption. Additionally, a regulatory PSD increment analysis has to include all historic emission changes since the PSD trigger date, which extends back to 1978 for the area around Colstrip. Both increment expansion and consumption have occurred since that date. An analysis of this sort is beyond the scope of this project. MDEQ, in cooperation with the Northern Cheyenne Tribe and EPA, is conducting this type of analysis and the results will be factored into the new source review process in permitting additional CBNG sources in the study area.
- Monitoring data in Wyoming has indicated an upward trend in particulate matter concentrations in Campbell County since 1999, which coincides

with CBNG development but is also exacerbated by prolonged drought in the region.

Given these assumptions, the model represents an estimate of potential air quality impacts in the project area and region.

It is important to note that before actual development could occur, the applicable air quality regulatory agencies (including the state, tribe, or EPA) would review specific air pollutant emissions preconstruction permit applications that examine potential project-wide air quality impacts for some categories of sources. As part of these permits (depending on source size), the air quality regulatory agencies could require additional air quality impacts analyses or mitigation measures. Thus, before development occurs, additional site-specific air quality analyses would be performed to ensure protection of air quality. Emission sources that would violate standards would not be permitted.

Impacts from Management Common to All Alternatives

Air quality impacts would occur during construction (due to surface disturbance by earth-moving equipment, vehicle traffic fugitive dust, well testing and drilling rig and vehicle engine exhaust) and production (including well production equipment and field and sales compression engine exhausts), as well as emissions associated with secondary growth. The amount of air pollutant emissions during construction and production would be controlled by watering; applying chemical stabilizers, surface material or reseeded vegetation to disturbed soils; and by air pollutant emission limitations imposed by applicable oil and gas lease management agencies and air quality regulatory agencies. Actual air quality impacts depend on the amount, duration, location and characteristics of potential emissions sources, as well as meteorological conditions (wind speed and direction, precipitation, etc.).

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Impacts to air quality would be minimal under this alternative. Based on air quality modeling of potential near-field (direct, indirect and cumulative) air quality impacts (Argonne 2002), localized short-term increases in CO, NO_x, SO_2 and PM_{10} concentrations could occur, but most maximum concentrations are expected to be below applicable state and National Ambient Air Quality Standards (NAAQS), as well as NAAQS PSD increments, as shown in Table 4-8. These results are for near-field modeling. Far-field modeling results were also found to be below NAAQS and PSD Increments (Additional data on near and far-field modeling results are contained in the Air Appendix – Part 1).

Alternative A project source emissions would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact is an ANC change of 0.65 percent which equates to a 0.04 μeq/l change. This is below threshold level of 1.0 μeq/l.

Direct visibility impacts from Alternative A project source emissions are predicted to be limited to the Class II, Crow Reservation. Up to 2 days annually were predicted to have a greater than "just noticeable change based on Alternative A project source emissions only. The Alternative A sources are predicted to have no direct impact on visibility in the other Class I and Class II areas (as shown in Table 4-11, under the "Project Sources Only" column.)

Cumulative Impacts

Given the extensive non-project emission sources located throughout the analysis region (including CBNG developments in the Wyoming section of the Powder River Basin), there is a potential for cumulative air quality impacts from Alternative A project sources and non-project sources to exceed applicable thresholds under Alternative A. Two receptor points south of the Spring Creek Coal Mine had a maximum near-field cumulative impact of 104 $\mu g/m^3$ for 24-hour PM_{10}. When combined with the assumed background level of 105 $\mu g/m^3$, the total impact of 210 $\mu g/m^3$ would exceed the 24-hour PM_{10} NAAQS of 150 $\mu g/m^3$. Note that the Alternative A project sources contribute a maximum of 1.8 $\mu g/m^3$, as shown in Table 4-9. (Note: The contributions from each source represent maximums and do not necessarily occur at the same location. Therefore the sum of the individual contributions will not always equal the cumulative totals.)

In addition, non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Reservation, as well as the PSD Class II increment, near the maximum assumed development area (see Table 4-10). For the Northern

TABLE 4-8

ALTERNATIVE A—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Pollutant	Averaging Time	Project Modeled Impact ($\mu g/m^3$)	PSD Increments [a] ($\mu g/m^3$) Class II	Montana Background ($\mu g/m^3$)	Total Impact [b] ($\mu g/m^3$)	Montana AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	1.94	25	11	12.9	100	100
	1-hour	20.6	n/a	117	138	566	n/a
SO_2	Annual	0.27	20	16	16	60	80
	24-hour	0.87	91	73	74	260	365
	3-hour	1.54	512	291	293	n/a	1,300
	1-hour	1.86	n/a	666	668	1,300	n/a
PM_{10}	Annual	0.52	17	30	31	50	Revoked
	24-hour	1.83	30	105	107	150	150
$PM_{2.5}$	Annual	0.27	n/a	8	8	15	15
	24-hour	0.97	n/a	20	21	35	35
CO	8-hour	29.78	n/a	6,600	6,630	10,000	10,000
	1-hour	49.4	n/a	15,000	15,049	26,000	40,000

[a] PSD Increment is to be compared to the Project Modeled Impact.
[b] Total Impact is the sum of the Project Modeled Impact and Background values.
n/a – not applicable

TABLE 4-9

ALTERNATIVE A POTENTIAL NAAQS/MAAQS EXCEEDANCES

		Contributions ($\mu g/m^3$)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Back-ground	Cumulative Total	NAAQS/ MAAQS
Near-Field	PM_{10} 24-hr	1.8	n/a	104	105	210	150/150

TABLE 4-10

ALTERNATIVE A POTENTIAL PSD INCREMENT EXCEEDANCES

		Contributions ($\mu g/m^3$)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	PSD Class I Increment	PSD Class II Increment
Northern Cheyenne Reservation	PM_{10} 24-hr	0.5	n/a	8.4	8.7	8	n/a
Near-Field	PM_{10} 24-hr	1.8	n/a	104	105	n/a	30

n/a – not applicable

Cheyenne Reservation the far-field analysis indicated a maximum increment level of 8.7 $\mu g/m^3$ with the non-project sources contributing 8.4 $\mu g/m^3$ and the Alternative A project sources contributing up to 0.5 $\mu g/m^3$. All NEPA analysis comparisons to PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD increment consumption analysis.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 μeq/l), the predicted cumulative impact of 1.6 μeq/l change would exceed the threshold level of 1.0 μeq/l. Approximately 2.5 percent of this change would be attributable to Alternative A project sources alone. It should be noted that the very low background ANC level is based on only four samples taken on 3 days between 1997 and 2000.

Potential visibility impacts were predicted to occur from non-project sources alone in every sensitive area analyzed (see Table 4-11). The Alternative A project sources in themselves were predicted to have a negligible direct impact on these areas (exception is the Class II Crow Reservation). However, the cumulative analysis predicted an average daily visibility impact increase of approximately 1 day per year for some Class I sensitive areas. Of the 15 mandatory federal PSD Class I areas analyzed, cumulative average annual impacts would occur at the Fitzpatrick Wilderness Area (up to 10 days per year); the Scapegoat Wilderness Area (up to 3 days per year); the Teton Wilderness Area (up to 10 days per year); the Washakie Wilderness Area (up to 15 days per year); and Wind Cave National Park (up to 28 days per year).

Up to 42 days annually were predicted to have a greater than "just noticeable change" within the re-designated PSD Class I Northern Cheyenne Reservation based on cumulative impact. The Alternative A project sources are predicted to have no direct impact on visibility whereas the non-project sources are predicted to have an impact of up to 38 days annually.

The maximum potential cumulative visibility impacts (Table 4-12) predicted at the PSD Class II Crow Reservation were 69 days per year with Alternative A project sources directly contributing up to 2 days per year and non-project sources contributing up to 61 days per year. Fewer cumulative impacts were predicted at other PSD Class II sensitive receptors, including the Absaroka-Beartooth Wilderness Area (30 days per year), the Bighorn Canyon National Recreation Area (23 days per year), the Cloud Peak Wilderness Area (30 days per year), Devils Tower National Monument (39 days per year) and Jewel Cave National Monument (32 days per year). The Alternative A project sources contributed generally 1 to 2 days per year to these cumulative totals. Note that visibility impacts are due to $PM_{2.5}$, NO_2 and SO_2 emissions from project and non-project sources.

Crow Reservation

Given the proximity of proposed Alternative A emission sources near or on the Crow Reservation, it is understandable that several of the maximum air pollutant impacts would occur on tribal lands. All direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Crow Reservation: up to 2 days per year from Alternative A project sources directly; up to 61 days per year from non-project sources; and up to 69 days per year from all sources cumulatively.

Northern Cheyenne Reservation

Given the proximity of proposed Alternative A emission sources near or on the Northern Cheyenne Reservation, it is understandable that some of the maximum air pollutant impacts would occur on tribal lands. With the exception of a potential non-project and cumulative sources exceedance of the 24-hour PM_{10} Class I Increments, all direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Northern Cheyenne Reservation: no increased haze days per year from Alternative A project sources directly; up to 38 days per year from non-project sources and up to 42 days per year from all sources cumulatively.

Potential Mitigation

Roads and well locations constructed on soils susceptible to wind erosion could be appropriately surfaced to reduce the amount of fugitive dust generated by traffic or other activities. Dust inhibitors (i.e., surfacing materials, non-saline dust suppressants, water, etc.) could be used as necessary on unpaved collector, local and resource roads, which present a fugitive dust problem. To further reduce fugitive dust, operators could establish and enforce speed limits (i.e., 15 miles per hour [mph]) on all project-required roads in and adjacent to the project area.

TABLE 4-11

ALTERNATIVE A CLASS I AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv[1]
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	
Badlands Wilderness Area	0	n/a	17 to 25	18 to 25	10.0
Bridger Wilderness Area	0	n/a	8 to 10	8 to 10	10.9
Fitzpatrick Wilderness Area	0	n/a	7 to 9	8 to 10	13.5
Fort Peck Reservation	0	n/a	1 to 2	2 to 2	6.0
Gates of the Mountains Wilderness Area	0	n/a	3 to 4	3 to 4	12.7
Grand Teton National Park	0	n/a	4 to 6	4 to 6	5.8
Northern Absaroka Wilderness Area	0	n/a	10 to 12	11 to 12	11.3
Northern Cheyenne Reservation	0	n/a	30 to 38	33 to 42	39.9
Red Rock Lakes Wilderness Area	0	n/a	0 to 1	0 to 1	2.3
Scapegoat Wilderness Area	0	n/a	2 to 2	2 to 3	8.2
Teton Wilderness Area	0	n/a	7 to 9	7 to 10	11.9
Theodore Roosevelt National Park (North Unit)	0	n/a	1 to 2	1 to 2	3.3
Theodore Roosevelt National Park (South Unit)	0	n/a	2 to 4	2 to 4	3.9
U.L. Bend Wilderness Area	0	n/a	5 to 5	5 to 6	23.7
Washakie Wilderness Area	0	n/a	11 to 14	12 to 15	20.
Wind Cave National Park	0	n/a	21 to 27	22 to 28	7.7
Yellowstone National Park	0	n/a	9 to 11	9 to 11	9.0

[1]Δdv – change in deciview

TABLE 4-12

ALTERNATIVE A CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	
Absaroka Beartooth Wilderness Area	0	n/a	28 to 29	28 to 30	15.2
Agate Fossils Bed National Monument	0	n/a	10 to 15	10 to 15	10.4
Bighorn Canyon National Recreation Area	0	n/a	19 to 21	19 to 23	28.2
Black Elk Wilderness Area	0	n/a	20 to 26	20 to 26	8.4
Cloud Peak Wilderness Area	0	n/a	21 to 28	23 to 30	13.9
Crow Reservation	2	n/a	56 to 61	65 to 69	53.0
Devils Tower National Monument	0	n/a	24 to 38	26 to 39	9.7
Fort Belknap Reservation	0	n/a	60 to 61	61 to 61	23.6
Fort Laramie National Historic Site	0	n/a	13 to 17	13 to 17	14.4
Jewel Cave National Monument	0	n/a	24 to 31	24 to 32	11.0
Mount Rushmore National Memorial	0	n/a	17 to 22	17 to 22	7.5
Popo Agie Wilderness Area	0	n/a	8 to 10	8 to 10	11.9
Soldier Creek Wilderness Area	0	n/a	13 to 18	13 to 18	9.3

Potential emission reduction measures (BLM 1999d) are available to further limit NO_x and other pollutant emissions. The appropriate level of control would be determined and required by the applicable air quality regulatory agencies during the preconstruction permit process. Visibility impacts would be mitigated by reducing emissions of $PM_{2.5}$, NO_2 and SO_2.

Compressor emissions could be reduced by any of the following methods:

- **Reduce Compression Requirements.** Reduce the need for life of project compression by limiting the need for field compressors.
- **Electric Compression.** Using electric-powered compressor motors in place of the typical natural gas-fired compressor engines could eliminate direct NO_x emissions from compressor station locations.
- **Best Available Control Technology (BACT).** MDEQ would probably require BACT for compressor engines. Compressor engines would have an average potential NO_x emission rate of less than the 1.5 grams per horsepower per hour (b/bhp-hr) used in the modeling assessment.

Additional discussion of particulate and NO_x emission mitigation measures is provided in the Air Quality Appendix – Part 1. Mitigation measures for particulate matter have also been included in the Air Quality Appendix of this FSEIS. Some of these measures have been incorporated as management features of the alternatives (see Table 2-1 and Table 2-2 in Chapter 2).

Conclusion

Future development activities must comply with applicable local, state, tribal and federal air quality laws, statutes, regulations, standards, increments and implementation plans. Increases in air pollutant emissions would occur under Alternative A. Given the assumptions applied in this analysis, it is unlikely direct air quality impacts from Alternative A project sources would violate any local, state, tribal, or federal air quality standards. When combined with other non-project emission sources, the 24-hour PM_{10} PSD Class II increment and NAAQS was predicted to be exceeded near the Spring Creek Coal Mine. Additionally, the cumulative impact of Alternative A project and non-project sources were predicted to exceed the 24-hour PM_{10} PSD Class I increment at the Northern Cheyenne Reservation. Finally, cumulative air quality impacts were predicted to exceed: 1) atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area; and 2) visibility impact thresholds in all sensitive federal PSD Class I and Class II areas.

Alternative B—CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

There is the potential for direct air quality impacts to occur under this alternative. Based on air quality modeling of potential near-field (direct, indirect and cumulative) air quality impacts (Argonne 2002), localized short-term increases in CO, NO_x, SO_2 and PM_{10} concentrations could occur and some maximum concentrations are predicted to be above applicable state and NAAQS and PSD increments.

The modeled impacts from project sources are shown in Table 4-13. These results, which are all below the Montana Ambient Air Quality Standards (MAAQS), NAAQS and PSD increments, are for near-field modeling. Far-field modeling results for project sources are also below the MAAQS, NAAQS and PSD Increments. (Refer to "Project Sources Only" columns in the following tables.)

Alternative B project sources by themselves would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact is an ANC change of 3.3 percent, which equates to a 0.19 μeq/l change. This is below threshold level of 1.0 μeq/l.

Even without other development in the region, Alternative B project sources alone may impact visibility within seven mandatory federal PSD Class I Areas. Impacts greater than a "just noticeable change" of 1.0 dv was predicted to average 3 days per year within the Washakie Wilderness Area (maximum 3.7 Δdv), 2 days per year within the Bridger, Fitzpatrick and North Absaroka Wilderness Areas (maximum 2.4, 2.3 and 3.6 Δdv, respectively and 1 day per year within the Teton Wilderness Area, U.L. Bend Wilderness Area and Yellowstone National Park (maximum 2.1, 4.3 and 3.0 Δdv, respectively). Given their proximity to anticipated Alternative B project sources, average annual visibility changes were also predicted to occur on up to 33 days within the re-designated PSD Class I Northern Cheyenne Reservation (maximum 13.4 Δdv).

For PSD Class II areas, Alternative B project sources were predicted to impact visibility of greater than 1.0 dv on 9 days within the Bighorn Canyon National

TABLE 4-13

ALTERNATIVE B—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Pollutant	Averaging Time	Project Modeled Impact ($\mu g/m^3$)	PSD[1] Increments Class II ($\mu g/m^3$)	Montana Background ($\mu g/m^3$)	Total[2] Impact ($\mu g/m^3$)	Montana AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	9.1	25	11	20.1	100	100
	1-hour	99.7	n/a	117	217	566	n/a
SO_2	Annual	0.66	20	16	17	60	80
	24-hour	2.1	91	73	75	260	365
	3-hour	3.5	512	291	295	n/a	1,300
	1-hour	4.6	n/a	666	671	1,300	n/a
PM_{10}	Annual	3.6	17	30	34	50	50
	24-hour	12.1	30	105	117	150	150
$PM_{2.5}$	Annual	1.4	n/a	8	9	15	15
	24-hour	6.2	n/a	20	26	65	65
CO	8-hour	74.1	n/a	6,600	6,674	10,000	10,000
	1-hour	109	n/a	15,000	15,109	26,000	40,000

[1] PSD Increment is to be compared to the Project Modeled Impact.
[2] Total Impact is the sum of the Project Modeled Impact and Background values.
n/a – not applicable

Recreation Area (maximum 5.4 Δdv) and on up to 61 days within the PSD Class II Crow Reservation (maximum 21.5 Δdv). Less extensive potential direct visibility impacts were also predicted for the PSD Class II Absaroka-Beartooth Wilderness Area (up to 2 days per year, max. 5.0 Δdv), Cloud Peak Wilderness Area (up to 6 days per year, max. 3.8 Δdv), Popo Agie Wilderness Area (up to 2 days per year, max. 2.6 Δdv), Devils Tower National Monument (up to 1 day per year, max. 2.8 Δdv) and Fort Belknap Reservation (up to 1 day per year, max. 4.1 Δdv).

Temporary Impacts

Based on modeling, the potential maximum 24-hour average PM_{10} concentration due to fugitive dust emissions from the largest construction site of the Montana Project (6-acre sales compressor station with a two-track road 480 m long and 12 m wide) was estimated to be about 57 $\mu g/m^3$, occurring about 400 m away from the center of construction site and about 200 m from the road. Although the temporary, short-term impacts of fugitive dust emissions from a construction site are not usually subjected to the requirements of ambient air quality standards, the total PM_{10} concentration, including the contributions from the largest construction site of the Montana Project, was estimated and compared with applicable MAAQS and NAAQS. Adding the estimated potential maximum 24-hour average PM_{10} concentration increase of 57 $\mu g/m^3$ to the background concentration of 105 $\mu g/m^3$ would amount to a total concentration of about 162 $\mu g/m^3$, which is about 108 percent of MAAQS. All other construction sites of the Montana Project would be smaller in size than the 6-acre sales compressor station construction site and therefore, potential PM_{10} concentration impacts at these smaller sites would be less.

In addition, it is anticipated temporary electrical generators would be used during construction of the compressor stations. The exact number of temporary natural gas and diesel generators for compressor stations cannot be predicted, but typical emission factors were used to estimate the near-field impacts from one temporary diesel generator. The potential ground-level concentrations resulting from operation of a temporary generator are as follows: CO 1-hour up to 403 $\mu g/m^3$, CO 8-hour up to 243 $\mu g/m^3$; NO_2 24-hour up to 7.5 $\mu g/m^3$; NO_2 annual up to 5.3 $\mu g/m^3$; $PM_{2.5}$ 3-hour up to 0.4 $\mu g/m^3$; $PM_{2.5}$ annual up to 0.4 $\mu g/m^3$; SO_2 3-hour up to 0.4 $\mu g/m^3$; SO_2 24-hour up to 0.3 $\mu g/m^3$; and SO_2 annual up to 0.013 $\mu g/m^3$. All concentrations are well below the ambient air quality standards.

The HAP impact analysis was based on a maximum assumed six-unit reciprocating compressor engine station as described in the Air Quality Appendix. Since neither the MDEQ nor EPA have established HAP standards, predicted 8-hour HAP concentrations were compared to a range of 8-hour state maximum Acceptable Ambient Concentration Levels (USEPA 1997a). Formaldehyde was the only HAP predicted to exceed even the lowest threshold level. The maximum predicted cumulative 8-hour formaldehyde impact was 11.9 $\mu g/m^3$, which is within the threshold range of 4.5 $\mu g/m^3$ (Pinnellas County Air Pollution Control Board, Florida) to 71 $\mu g/m^3$ (State of Nevada, Division of Environmental Protection, Air Quality Control). The maximum formaldehyde concentration was predicted to occur at 85 meters (less than 300 feet) adjacent to a compressor station; as the distance from the emission source increases, the predicted concentrations decrease rapidly.

Analysis was conducted to determine the possible incremental cancer-risk over a 70 year lifetime for a most likely exposure (MLE) to residents and to a maximally exposed individual (MEI), such as compressor station workers. These cancer risks were calculated based on the maximum predicted annual concentrations, EPA's unit risk factors for carcinogenic compounds (EPA 1997b) and an adjustment for time spent at home or on the job. This analysis assumed that residential exposure would be 20 years (well over the national nine year average duration a family lives at a residence) and worker exposure would be 20 years (the full life of project). In addition, it was assumed that family members would be exposed to the maximum formaldehyde concentrations 64 percent of the day and to one fourth of this concentration for the remaining 36 percent of the day.

The resulting incremental cancer risks were calculated to be 1.6×10^{-6} (MLE) and 2.2×10^{-6} (MEI). Both of these values fall near the lower end of the 1 to 100×10^{-6} threshold. The MLE and MEI cancer risks would fall below this threshold at 310 and 460 meters away from the emission source, respectively. This distance would be even less for smaller compressors.

Cumulative Impacts

Given the non-project emission sources located throughout the analysis region, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative B. Two receptor points south of the Spring Creek Coal Mine had a maximum near-field cumulative impact of 107 $\mu g/m^3$ for 24-hr PM_{10}. When combined with the assumed background level of 105 $\mu g/m^3$, the total impact of 211 $\mu g/m^3$ would exceed the 24-hour PM_{10} NAAQS of 150 $\mu g/m^3$. The Alternative B project sources contribute a maximum 12.1 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 13.1 $\mu g/m^3$ and the non-project sources contributed 104 $\mu g/m^3$. (Note: The contributions from each source represent maximums and do not necessarily occur at the same location. Therefore the sum of the individual contributions will not always equal the cumulative totals.)

Furthermore, a maximum near-field cumulative impact for 24-hour $PM_{2.5}$ was determined to be 46 $\mu g/m^3$. When combined with the assumed background level of 20 $\mu g/m^3$, the total impact of 66 $\mu g/m^3$ would exceed the 24-hour $PM_{2.5}$ NAAQS of 65 $\mu g/m^3$. Note that the Alternative B project sources contribute a maximum 6.2 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 6.9 $\mu g/m^3$ (see Table 4-14).

In addition, Alternative B non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Reservation and the Washakie Wilderness area. For the Northern Cheyenne Reservation the far-field analysis indicated a maximum increment level of 12.8 $\mu g/m^3$ with the non-project sources contributing 8.4 $\mu g/m^3$ and project sources contributing up to 4.2 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 5.9 $\mu g/m^3$.

For the Washakie Wilderness Area the far-field analysis indicated a maximum increment level of 9.2 $\mu g/m^3$ with the non-project sources contributing 7.2 $\mu g/m^3$ and project sources contributing up to 1.4 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 2.0 $\mu g/m^3$.

Alternative B non-project sources also have the potential to exceed the PSD Class I increment for annual NO_2 on the Northern Cheyenne Reservation (see Table 4-15). The far-field analysis indicated a maximum increment level of 4.2 $\mu g/m^3$ with the non-project sources contributing 0.5 $\mu g/m^3$ and project sources contributing up to 1.9 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 3.7 $\mu g/m^3$.

TABLE 4-14

ALTERNATIVE B POTENTIAL NAAQS/MAAQS EXCEEDANCES

Location	Pollutant	Contributions ($\mu g/m^3$) Project Sources Only	Project + RFFA Sources	Non-Project Sources	Back-ground	Cumulative Total	NAAQS/MAAQS
Near-Field	$PM_{2.5}$ 24-hr	6.2	6.9	44.1	20	66	65/---
Near-Field	PM_{10} 24-hr	12.1	13.1	104	105	212	150/150

TABLE 4-15

ALTERNATIVE B POTENTIAL PSD INCREMENTS EXCEEDANCES

Location	Pollutant	Contributions ($\mu g/m^3$) Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	PSD Class I Increment	PSD Class II Increment
Northern Cheyenne Reservation	PM_{10} 24-hr	4.2	5.9	8.4	12.8	8	n/a
Northern Cheyenne Reservation	NO_2 Annual	1.9	3.7	0.5	4.2	2.5	n/a
Washakie Wilderness Area	PM_{10} 24-hr	1.4	2.0	7.2	9.2	8	n/a
Near-Field	PM_{10} 24-hr	12.1	13.1	103.8	107	n/a	30

For Class II areas near the Spring Creek Coal Mine, the cumulative impact of 107 $\mu g/m^3$ exceeds the Class II increment of 30 $\mu g/m^3$ for 24-hour PM_{10}. The non-project source contribution was predicted to be up to 104$\mu g/m^3$ and the project source contribution was predicted to be up to 12.1 $\mu g/m^3$ alone. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 13.1 $\mu g/m^3$.

All NEPA analysis comparisons to PSD increments are intended to evaluate a threshold of concern. They do not represent a regulatory PSD increment consumption analysis.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 µeq/l), the predicted cumulative impact of 1.8 µeq/l change would exceed the threshold level of 1.0 µeq/l. Approximately 11 percent of this change would be attributable to Alternative B project sources alone. Additionally, the potential cumulative impact of 10.4 µeq/l change would exceed the threshold level of 10 µeq/l for Florence Lake in the Class II Cloud Peak Wilderness Area.

Note that potential visibility impacts were predicted to occur from Alternative B non-project sources alone in every sensitive area analyzed. When Alternative B project sources are included in the cumulative analysis, average daily visibility impacts increase by 1 to 3 days per year at most areas, except the Northern Cheyenne Reservation and Class II Crow Reservation. Both are located near the potential Alternative B sources.

Cumulative impacts from non-project, Alternative B and RFFA sources are likely to degrade visibility within fourteen of the fifteen mandatory federal PSD Class I Areas. When Alternative B project sources are combined with the RFFA (Reservation and Forest Service) developments cumulative impacts resulted in an increase of 1 to 5 days per year, as shown in the table below. The cumulative impacts ranged from a total of 2 to 32 days per year for these Class I areas

with a maximum Δdv of 29.1 for the U.L. Bend Wilderness Area.

Modeled project sources could impact seven of the PSD Class I Areas. A "just noticeable change" of 1.0 dv was predicted to average 3 day per year within the Washakie Wilderness Area, 2 days per year within the Bridger, Fitzpatrick and North Absaroka Wilderness Areas and 1 day per year within the Teton Wilderness Area, U.L. Bend Wilderness Area and Yellowstone National Park (see Table 4-16).

Given their proximity to anticipated Alternative B emission sources, cumulative average annual visibility changes were also predicted to occur on up to 92 days per year within the re-designated PSD Class I Northern Cheyenne Reservation. The maximum Δdv was modeled to be 54.8. Project sources alone contributed up to 33 days per year. The project sources combined with the RFFA (Reservation and Forest Service) developments contribute a total of 60 days per year. Although no direct visibility impacts to the Fort Peck Reservation may be attributable to Alternative B project sources, the cumulative impact was predicted to increase 3 days per year with a maximum Δdv of 7.4.

For PSD Class II areas, cumulative impacts from project sources combined with the RFFA (Reservation and Forest Service) sources and non-project sources were predicted to be 11 days to 116 days per year, as shown in Table 4-17 below with a maximum Δdv of 66.9 (on Crow Reservation). The Alternative B project sources combined with RFFA sources contributed generally 1 to 55 days per year to these cumulative totals. Alternative B project source impacts were predicted to occur on 9 days within the Bighorn Canyon National Recreation Area and on up to 61 days within the PSD Class II Crow Reservation. Less extensive potential direct visibility impacts were also predicted for the PSD Class II Absaroka-Beartooth Wilderness Area (up to 9 days per year), Cloud Peak Wilderness Area (up to 6 days per year), Popo Agie Wilderness Area (up to 2 days per year), Devils Tower National Monument (up to 1 day per year) and Fort Belknap Reservation (up to 1 day per year). Note that visibility impacts are due to $PM_{2.5}$, NO_2 and SO_2 emissions from project and non-project sources.

TABLE 4-16

ALTERNATIVE B CLASS I AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	
Badlands Wilderness Area	0	0	17 to 25	21 to 28	10.9
Bridger Wilderness Area	2	3	8 to 10	10 to 12	13.3
Fitzpatrick Wilderness Area	2	3	7 to 9	10 to 12	16.6
Fort Peck Reservation	0	1	1 to 2	4 to 5	7.4
Gates of the Mountains Wilderness Area	0	0	3 to 4	4 to 4	15.0
Grand Teton National Park	0	0	4 to 6	6 to 8	7.0
Northern Absaroka Wilderness Area	2	4	10 to 12	13 to 15	14.9
Northern Cheyenne Reservation	33	60	30 to 38	87 to 92	54.8
Red Rock Lakes Wilderness Area	0	0	0 to 1	2 to 3	2.9
Scapegoat Wilderness Area	0	0	2 to 2	3 to 3	9.9
Teton Wilderness Area	1	3	7 to 9	10 to 11	14.6
Theodore Roosevelt National Park (North Unit)	0	0	1 to 2	2 to 3	3.7
Theodore Roosevelt National Park (South Unit)	0	1	2 to 4	4 to 7	4.6
U.L. Bend Wilderness Area	1	1	5 to 5	6 to 8	29.1
Washakie Wilderness Area	3	5	11 to 14	16 to 18	24.8
Wind Cave National Park	0	0	21 to 27	25 to 32	9.1
Yellowstone National Park	1	3	9 to 11	12 to 13	12.8

TABLE 4-17

ALTERNATIVE B CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	
Absaroka Beartooth Wilderness Area	2	4	28 to 29	32 to 33	21.5
Agate Fossils Bed National Monument	0	0	10 to 15	14 to 19	12.8
Bighorn Canyon National Recreation Area	9	17	19 to 21	32 to 34	34.0
Black Elk Wilderness Area	0	1	20 to 26	24 to 31	9.4
Cloud Peak Wilderness Area	6	10	21 to 28	35 to 39	16.3
Crow Reservation	61	75	56 to 61	113 to 116	66.9
Devils Tower National Monument	1	3	24 to 38	34 to 47	11.4
Fort Belknap Reservation	1	1	60 to 61	61 to 62	28.4
Fort Laramie National Historic Site	0	1	13 to 17	16 to 20	16.9
Jewel Cave National Monument	0	0	24 to 31	28 to 36	12.1
Mount Rushmore National Memorial	0	0	17 to 22	20 to 26	8.4
Popo Agie Wilderness Area	2	3	8 to 10	11 to 13	14.6
Soldier Creek Wilderness Area	0	0	13 to 18	16 to 21	11.4

Crow Reservation

Given the proximity of proposed Alternative B emission sources near or on the Crow Reservation, it is understandable that air pollutant impacts would occur on tribal lands. All direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Crow Reservation: up to 61 days per year from Alternative B project sources directly; up to 75 days per year from project and RFFA sources; up to 61 days per year from non-project sources; and up to 116 days per year from all sources cumulatively. The maximum Δdv was 66.9.

Northern Cheyenne Reservation

Given the proximity of proposed Alternative B emission sources near or on the Northern Cheyenne Reservation, it is understandable that some of the maximum air pollutant impacts could occur on tribal lands. With the exception of a potential non-project and cumulative source exceedance of the 24-hour PM_{10} and annual NO_2 Class I Increments, all direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Northern Cheyenne Reservation: up to 33 days per year from Alternative B project sources directly; up to 60 days per year from project and RFFA sources; up to 38 days per year from non-project sources and up to 92 days per year from all sources cumulatively. The maximum Δdv was 54.5.

Mitigation

Potential mitigation measures to further reduce potential air quality impacts from Alternative B sources would be the same as those presented for Alternative A sources above.

Conclusion

Future development activities must comply with applicable local, state, tribal and federal air quality laws, statutes, regulations, standards, increments and implementation plans. Increases in air pollutant emissions that could occur under Alternative B, resulting in direct air quality impacts would not be permitted. It is unlikely direct air quality impacts

from Alternative B project sources alone would violate local, state, tribal or federal air quality standards.

When Alternative B project source impacts are combined with the RFFA (Reservation and Forest Service) sources and non-project sources, the 24-hour PM_{10} NAAQS and the 24-hour $PM_{2.5}$ NAAQS were predicted to be exceeded near the Spring Creek Coal Mine. In addition, cumulative impact of Alternative B project, RFFA and non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} and PSD Class I Increment for annual NO_2 on the Northern Cheyenne Reservation, as well as the PSD Class I increment for 24-hour PM_{10} on the Washakie Wilderness area.

For Class II areas near the Spring Creek Coal Mine, the cumulative impact of 107 $\mu g/m^3$ exceeds the Class II increment of 30 $\mu g/m^3$ for 24-hour PM_{10}.

Finally, cumulative air quality impacts were predicted to exceed: 1) atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area and in Florence Lake in the Class II Cloud Peak Wilderness Area; and 2) visibility impact thresholds in all PSD Class I and Class II area (including 15 mandatory federal PSD Class I areas) included in this analysis.

Alternative C—Emphasize CBNG Development

Potential direct and cumulative air quality impacts are comparable to Alternative B.

Alternative D—Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

Potential direct air quality impacts could occur under this alternative. Based on air quality modeling of potential near-field (direct, indirect and cumulative) air quality impacts (Argonne 2002), localized short-term increases in CO, NO_x, SO_2 and PM_{10} concentrations could occur, but most maximum concentrations are expected to be below applicable state and NAAQS, as well as NAAQS PSD increments and some maximum concentrations are predicted to be above applicable state and NAAQS and PSD increments.

The modeled impacts from project sources only are shown in Table 4-18 below. These results, which are all below the MAAQS, NAAQS and PSD increments, are for near-field modeling. Far-field modeling results for project sources were also found to be below the MAAQS, NAAQS and PSD Increments. (Refer to "Project Sources Only" columns in the following tables.)

Alternative D project sources by themselves would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact is an ANC change of 1.8 percent, which equates to a 0.1 μeq/l change. This is below threshold level of 1.0 μeq/l set as the level of significant impact.

Alternative D project sources by themselves are likely to directly degrade visibility within one mandatory federal PSD Class I Area. A greater than "just noticeable change" of 1.0 dv was predicted to average 1 day per year within the Washakie Wilderness Area (maximum 2 Δdv) and up to 17 days within the re-designated PSD Class I Northern Cheyenne Reservation (maximum 8 Δdv).

For PSD Class II areas, Alternative D project sources were predicted to impact visibility greater than 1.0 dv on 3 days within the Bighorn Canyon National Recreation Area (maximum 3 Δdv), 1 day within the Cloud Peak Wilderness Area (maximum 2 Δdv) and up to 42 days within the PSD Class II Crow Reservation (maximum 11 Δdv).

Temporary Impacts

Temporary impacts for Alternative D are expected to be comparable to those described under Alternative B.

Cumulative Impacts

Given the non-project emission sources located throughout the analysis region, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative D (see Table 4-19). Two receptor points south of the Spring Creek Coal Mine had a maximum near-field cumulative impact of 106 $\mu g/m^3$. When combined with the assumed background level of 105 $\mu g/m^3$, the total impact of 211 $\mu g/m^3$ would exceed the 24-hour PM_{10} NAAQS of 150 $\mu g/m^3$. The Alternative D project source emissions would contribute a maximum of 10.8 $\mu g/m^3$ alone. The project and RFFA sources combined would contribute a maximum of 11.5 $\mu g/m^3$. (Note: The contributions from each source represent maximums and do not necessarily occur at the same location. Therefore the sum of the individual contributions will not always equal the cumulative totals.)

TABLE 4-18

ALTERNATIVE D—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Pollutant	Averaging Time	Project Modeled Impact ($\mu g/m^3$)	PSD Increments[1] ($\mu g/m^3$) Class II	Montana Background ($\mu g/m^3$)	Total[2] Impact ($\mu g/m^3$)	Montana AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	6.4	25	17.4	20.1	100	100
	1-hour	49.5	n/a	167	217	566	n/a
SO_2	Annual	0.65	20	16.7	17	60	80
	24-hour	2.1	91	75.1	75	260	365
	3-hour	3.5	512	295	295	n/a	1,300
	1-hour	4.5	n/a	671	671	1,300	n/a
PM_{10}	Annual	3.3	17	33.3	34	50	50
	24-hour	10.8	30	116	117	150	150
$PM_{2.5}$	Annual	1.2	n/a	9.2	9	15	15
	24-hour	4.3	n/a	24.3	26	65	65
CO	8-hour	29.1	n/a	6,629	6,674	10,000	10,000
	1-hour	47.6	n/a	15,048	15,109	26,000	40,000

[1] PSD Increment is to be compared to the Project Modeled Impact.
[2] Total Impact is the sum of the Project Modeled Impact and Background values.
n/a – not applicable

TABLE 4-19

ALTERNATIVE D POTENTIAL PSD INCREMENTS EXCEEDANCES

		Contributions ($\mu g/m^3$)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Background	Cumulative Total	NAAQS/ MAAQS
Near-Field	$PM_{2.5}$ 24-hr	4.3	4.7	44.1	20	65	65/---
Near-Field	PM_{10} 24-hr	10.8	11.5	103.8	105	211	150/150

TABLE 4-20

ALTERNATIVE D POTENTIAL PSD INCREMENTS EXCEEDANCES

		Contributions ($\mu g/m^3$)					
Location	Pollutant	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	PSD Class I Increment	PSD Class II Increment
Northern Cheyenne Reservation	PM_{10} 24-hr	3.3	4.4	8.4	11.1	8	n/a
Washakie WSA	PM_{10} 24-hr	0.61	0.85	7.2	8.1	8	n/a
Near-Field	PM_{10} 24-hr	10.8	11.5	103.8	106.5	n/a	30

na=not applicable

Furthermore, a maximum near-field cumulative impact for 24-hour $PM_{2.5}$ was determined to be 45.3 $\mu g/m^3$. When combined with the assumed background level of 20 $\mu g/m^3$, the total impact of 65.3 $\mu g/m^3$ would exceed the 24-hour $PM_{2.5}$ NAAQS of 65 $\mu g/m^3$. Note that the Alternative D project sources contribute a maximum 4.3 $\mu g/m^3$ alone. The project and RFFA sources combined contribute 4.7 $\mu g/m^3$.

In addition, Alternative D non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Reservation (see Table 4-20). The far-field analysis indicated a maximum increment level of 9.8 $\mu g/m^3$ with the non-project sources contributing 8.4 $\mu g/m^3$ and the project sources contributing up to 3.3 $\mu g/m^3$ alone. The project and RFFA sources combined contribute 4.4 $\mu g/m^3$. The far-field analysis also indicated a maximum cumulative increment level of 8.1 $\mu g/m^3$ for the Washakie Wilderness Area. Non-project sources were determined to contribute 7.2 $\mu g/m^3$ and the project sources contributing up to 0.61 $\mu g/m^3$ alone. The project and RFFA sources combined contribute 0.85 $\mu g/m^3$.

For Class II areas near the Spring Creek Coal Mine, the cumulative impact of 106 $\mu g/m^3$ exceeds the Class II increment of 30 $\mu g/m^3$ for 24-hour PM_{10}. The non-project sources contribution was predicted to be up to 104 $\mu g/m^3$ and the project sources contributions were predicted to be up to 10.8 $\mu g/m^3$ alone. The project and RFFA sources combined contribute 11.5 $\mu g/m^3$.

All NEPA analysis comparisons to PSD increments are intended to evaluate a threshold of concern. They do not represent a regulatory PSD Increment Consumption Analysis.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 $\mu eq/l$), the predicted cumulative impact of 1.7 $\mu eq/l$ change would exceed the threshold level of 1.0 $\mu eq/l$. Approximately 6 percent of this change would be attributable to Alternative D project sources alone.

Note that potential visibility impacts were predicted to occur from Alternative D non-project sources alone in every sensitive area analyzed. When Alternative D project and RFFA sources are included in the cumulative analysis, the average daily visibility impacts increase by 1 to 2 days per year for thirteen of the fifteen areas as noted (see Table 4-21). The maximum Δdv was predicted to be 26.0 at the U.L. Bend Wilderness Area. Alternative D project sources alone are likely to directly degrade visibility within only one of the fifteen mandatory federal PSD Class I Areas. A change of 1.6 dv was predicted to average 1 day per year within the Washakie Wilderness Area.

For PSD Class II areas, Alternative D project source impacts were predicted to occur on up to 1 day within the Cloud Peak Wilderness Area (maximum 1.9 Δdv) and up to 3 days within the Bighorn Canyon National Recreation Area (maximum 2.6 Δdv). Cumulative impacts from project with RFFA sources and non-project sources were predicted to be up to 35 days and 28 days per year, respectively.

The Alternative D project sources with RFFA sources contributed generally 1 to 7 days per year to the cumulative totals for the Class II areas listed in Table 4-22. The maximum Δdv was predicted to be 30.6 at the Bighorn Canyon National Recreation Area and 59.3 at the Crow Reservation. Note that visibility impacts are due to $PM_{2.5}$, NO_2 and SO_2 emissions from project and non-project sources.

Crow Reservation

Given the proximity of proposed Alternative D emission sources near or on the Crow Reservation, it is understandable that air pollutant impacts would occur on tribal lands. All direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Crow Reservation: up to 42 days per year from Alternative D project sources directly; up to 56 days per year from project and RFFA sources combined; up to 61 days per year from non-project sources; and up to 105 days per year from all sources cumulatively. The maximum Δdv was predicted to be 59.3.

Northern Cheyenne Reservation

Given the proximity of proposed Alternative D emission sources near or on the Northern Cheyenne Reservation, it is understandable that air pollutant impacts would occur on tribal lands. With the exception of a potential non-project and cumulative source exceedance of the 24-hour PM_{10}

TABLE 4-21

ALTERNATIVE D CLASS I AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	
Badlands Wilderness Area	0	0	17 to 25	20 to 26	10.4
Bridger Wilderness Area	0	1	8 to 10	9 to 11	11.7
Fitzpatrick Wilderness Area	0	0	7 to 9	8 to 10	14.6
Fort Peck Reservation	0	0	1 to 2	2 to 3	6.5
Gates of the Mountains Wilderness Area	0	0	3 to 4	3 to 4	13.7
Grand Teton National Park	0	0	4 to 6	5 to 7	6.3
Northern Absaroka Wilderness Area	0	1	10 to 12	12 to 14	12.4
Northern Cheyenne Reservation	17	38	30 to 38	70 to 76	47.9
Red Rock Lakes Wilderness Area	0	0	0 to 1	1 to 2	2.6
Scapegoat Wilderness Area	0	0	2 to 2	2 to 3	8.9
Teton Wilderness Area	0	0	7 to 9	9 to 10	12.9
Theodore Roosevelt National Park (North Unit)	0	0	1 to 2	1 to 2	3.5
Theodore Roosevelt National Park (South Unit)	0	0	2 to 4	3 to 5	4.2
U.L. Bend Wilderness Area	0	0	5 to 5	5 to 6	26
Washakie Wilderness Area	1	1	11 to 14	14 to 16	21.9
Wind Cave National Park	0	0	21 to 27	23 to 29	8.2
Yellowstone National Park	0	0	9 to 11	11 to 12	10.5

TABLE 4-22

ALTERNATIVE D CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Project Sources Only	Project + RFFA Sources	Non-Project Sources	Cumulative Total	
Absaroka Beartooth Wilderness Area	0	1	28 to 29	30 to 31	17.8
Agate Fossils Bed National Monument	0	0	10 to 15	12 to 17	11.4
Bighorn Canyon National Recreation Area	3	7	19 to 21	25 to 28	30.6
Black Elk Wilderness Area	0	0	20 to 26	22 to 28	8.8
Cloud Peak Wilderness Area	1	2	21 to 28	28 to 35	14.9
Crow Reservation	42	56	56 to 61	102 to 105	59.3
Devils Tower National Monument	0	0	24 to 38	29 to 42	10.3
Fort Belknap Reservation	0	0	60 to 61	61 to 61	25.5
Fort Laramie National Historic Sites	0	0	13 to 17	15 to 18	15.5
Jewel Cave National Monument	0	0	24 to 31	26 to 34	11.5
Mount Rushmore National Monument	0	0	17 to 22	18 to 23	7.9
Popo Agie Wilderness Area	0	1	8 to 10	9 to 11	12.9
Soldier Creek Wilderness Area	0	0	13 to 18	14 to 20	10.1

Class I increments, all direct, indirect and cumulative impacts were predicted to comply with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Northern Cheyenne Reservation: up to 17 days per year from Alternative D project sources directly; up to 38 days per year from project and RFFA sources combined; up to 38 days per year from non-project sources; and, up to 76 days per year from all sources cumulatively. The maximum Δdv was predicted to be 47.9.

Mitigation

Potential mitigation measures to further reduce potential air quality impacts from Alternative D sources would be the same as those presented for Alternative A sources above.

Conclusion

Future development activities must comply with applicable local, state, tribal and federal air quality laws, statutes, regulations, standards, increments and implementation plans. Increases in air pollutant emissions would occur under Alternative D. Given the assumptions applied in this analysis, it is unlikely direct air quality impacts from Alternative D project sources alone would violate any local, state, tribal, or federal air quality standards.

When combined with Alternative D non-project sources and RFFA sources, the 24-hour PM_{10} NAAQS and 24-hour $PM_{2.5}$ NAAQS was predicted to be exceeded near the Spring Creek Coal Mine. In addition, the cumulative impact from Alternative D project sources with RFFA sources and non-project sources have the potential to exceed the PSD Class I increment for 24-hour PM_{10} on the Northern Cheyenne Reservation. For Class II areas near the Spring Creek Coal Mine, the cumulative impact is predicted to exceed the Class II increment for 24-hour PM_{10}.

Finally, cumulative air quality impacts were predicted to exceed: 1) atmospheric deposition thresholds in the very sensitive Upper Frozen Lake in the PSD Class I Bridger Wilderness Area; and 2) visibility impact thresholds in all PSD Class I and Class II areas (including 15 mandatory federal PSD Class I areas) included in this analysis.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts while Maintaining Existing Land Uses

Alternative E has been modeled in the FSEIS to allow direct comparison of the 2003 Final EIS preferred Alternative E to the new preferred Alternative H. The new air model was also used to predict impacts from Alternatives F and H. The new model incorporated an extended near-field receptor grid to include an expanded portion of the CBNG development area for both Montana and Wyoming, updated the emission inventories to the most currently available year (2004), added in the TRR as an RFFA and added emission sources identified by Environmental Defense Fund that were within the modeling domain. The new model also used three years of meteorological data initially to determine the meteorological year showing the highest impacts for the modeled base year (2004). The base year modeling indicated that meteorological year 2002 predicted the highest impacts and was chosen as the meteorological year for modeling future alternatives development. Assumptions used in the Statewide EIS for air emissions relating to CBNG development, as well as conventional oil and gas development, apply for the new modeling effort as well.

Under the new model, predicted impacts for the base year indicated the potential for localized short-term increases in NO_x, SO_2, PM_{10} and $PM_{2.5}$ concentrations. However, maximum concentrations were predicted to be below applicable state and NAAQS, as well as PSD increments. The new model incorporated the emissions used for base year modeling and adjusted the emission factors for non-project-related sources to account for changes to future emissions. This was done to allow a direct comparison of modeled impacts to applicable state and NAAQS, as well as PSD increments. Again, this was only done for comparative purposes; it does not constitute an effort to predict PSD increment consumption. In general, the base-year modeled impacts predicted ambient air concentrations that were higher than the monitored levels obtained for the year 2004.

Most source groups were modeled separately and, in some cases, were added together in the post-processing phase of modeling. This was done to provide a conservative estimate of impacts from various source groupings; in actuality, however, impacts were often at different receptors and occurred at different meteorological hours. A detailed description of the new model and predicted results are included in the Air Quality Appendix – Part 2.

Based on air quality modeling of potential near-field (direct, indirect and cumulative) air quality impacts,

localized short-term increases in NO_x, SO_2, PM_{10} and $PM_{2.5}$ concentrations could occur, but most maximum concentrations are expected to be below applicable state and NAAQS, as well as PSD increments. Additionally, the air quality permitting process would be used to analyze emission sources at the project level for CBNG development and to develop any needed mitigation. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

The modeled impacts from Montana CBNG sources only are shown in Table 4-23 below. These results for near-field modeling are all below the MAAQS, WAAQS and NAAQS; Far-field modeling results for project sources were also found to be below the MAAQS, NAAQS and most PSD increments. (Refer to "Project Sources Only" columns in the following tables.) The contributions from each source represent maximums and do not necessarily occur at the same location. Therefore, the sum of the individual contributions will not always equal the cumulative totals.

TABLE 4-23

ALTERNATIVE E PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Montana Impacts

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact ($\mu g/m^3$)	MT CBNG (Operation) Modeled Impact ($\mu g/m^3$)	Montana Base Year (All Sources) ($\mu g/m^3$)	PSD Increments[1] ($\mu g/m^3$) Class II	Montana AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	0.46	3.60	3.91	25	100	100
	1-hour	118.6	435	428	n/a	566	n/a
SO_2	Annual	0.04	0.10	1.71	20	60	80
	24-hour	0.56	0.98	15.1	91	260	365
	3-hour	3.54	4.82	43.9	512	n/a	1,300
	1-hour	10.57	11.51	140	n/a	1,300	n/a
PM_{10}	Annual	0.25	1.43	3.52	17	n/a	n/a
	24-hour	3.33	12.9	30.6	30	150	150
$PM_{2.5}$	Annual	0.01	0.20	0.88	n/a	15	15
	24-hour	0.10	2.16	6.83	n/a	35	35

Wyoming Impacts

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact ($\mu g/m^3$)	MT CBNG (Operation) Modeled Impact ($\mu g/m^3$)	Wyoming Base Year (All Sources) ($\mu g/m^3$)	PSD Increments[1] ($\mu g/m^3$) Class II	Wyoming AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	0.01	0.23	27.2	25	100	100
SO_2	Annual	0.001	0.01	17	20	60	80
	24-hour	0.01	0.06	124	91	260	365
	3-hour	0.03	0.22	552	512	1,300	1,300
PM_{10}	Annual	0.01	0.16	13.5	17	n/a	n/a
	24-hour	0.09	2.02	89.2	30	150	150
$PM_{2.5}$	Annual	0.004	0.07	2.11	n/a	15	15
	24-hour	0.04	1.10	9.4	n/a	35	35

[1] PSD increment is to be compared to the Montana CBNG modeled impact.
n/a – not applicable

Alternative E project sources by themselves would not result in an increase in ANC change above 10 percent for any Class I areas in the modeling domain. For the sensitive Upper Frozen Lake, within the mandatory federal PSD Class I Bridger Wilderness Area, the predicted impact would be an ANC change of 133 percent, which equates to a 2.6 μeq/l change. This is above the threshold level of 1.0 μeq/l set as the level of significant impact. However, this represents a 0.2 μeq/l change from the base year modeled impact of 2.4 μeq/l.

Using Visibility Method 2 indicates that Alternative E CBNG sources by themselves are likely to have an impact on visibility within ten mandatory federal PSD Class I Areas. A greater than "just noticeable change" of 1.0 dv was predicted to average up to 4 days per year within the Bridger Wilderness Area (maximum 2.3 Δdv), 3 days per year within the Fitzpatrick Wilderness Area (maximum 2.3 Δdv), 1 day per year within the Fort Peck Reservation (maximum 1.4 Δdv), 6 days per year within the North Absaroka Wilderness Area (maximum 2.5 Δdv), 2 days per year within the Teton Wilderness Area (maximum 1.2 Δdv), 3 days per year within Theodore Roosevelt National Park (maximum 1.3 Δdv), 6 days per year within the Washakie Wilderness Area (maximum 2.2 Δdv), 1 day per year within Wind Cave National Park (maximum 1.2 Δdv), 2 days per year within Yellowstone National Park (maximum 2.4 Δdv) and 235 days within the re-designated PSD Class I Northern Cheyenne Reservation (maximum 15.1 Δdv). Using Visibility Method 6 to predict visibility impacts indicatês that Alternative E project sources by themselves were predicted to have an impact on visibility within five mandatory federal PSD Class I areas. A greater than "just noticeable change" of 1.0 dv was predicted to average up to 1 day per year within the Fort Peck Reservation (maximum 1 Δdv), 3 days per year within the North Absaroka Wilderness Area (maximum 1.5 Δdv), 2 days per year within Theodore Roosevelt National Park (maximum 1.5 Δdv), 1 day per year within the UL Bend Wilderness Area (maximum 1 Δdv), 3 days per year within the Washakie Wilderness Area (maximum 1.2 Δdv) and 1 day per year within Yellowstone National Park (maximum 1.3 Δdv). Additionally, Alternative E project sources alone were predicted to impact visibility above 1.0 dv for 215 days within the designated PSD Class I Northern Cheyenne Reservation (maximum 13 Δdv).

Alternative E project sources were predicted with Visibility Method 6 to impact visibility greater than 1.0 dv on six PSD Class II areas. The model indicated up to 4 days per year within the Absaroka Beartooth Wilderness Area (maximum 3.3 Δdv), 24 days within the Bighorn Canyon National Recreation Area (maximum 3.5 Δdv), 9 days per year within the Cloud Peak Wilderness Area (maximum 7.1 Δdv), 248 days per year within the Crow Reservation (maximum 13.4 Δdv), 2 days per year within the Devils Tower National Monument (maximum 1.1 Δdv) and 4 days per year within the Wind River Reservation (maximum 1.3 Δdv).

Hazardous Air Pollutant Impacts

Estimates of HAPs impacts were developed for both 1-hour and annual near-field impacts for Montana CBNG sources. Results of the 1-hour modeled impacts for these modeling efforts were compared to the reference exposure levels (RELs) (EPA 1990). Short-term impacts for the six analyzed compounds (benzene, ethyl benzene, formaldehyde, n-hexane, toluene and xylene) were compared to the RELs. Results showed that all impacts were well below the RELs, except for formaldehyde in the Wyoming near-field receptor grid. Impacts are approximately 50 percent of the established acute REL for formaldehyde for Alternative E. In Montana, the 1-hour formaldehyde impact is approximately 18 percent or less of the established acute REL.

Temporary Impacts

Temporary impacts for Alternative E are expected to be comparable to those described under Alternative B.

Cumulative Impacts

Given the non-project emission sources located throughout the analysis region, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative E. However, none of the predicted impacts would exceed state or NAAQS.

The maximum predicted 1-hour NO_2 concentration for all sources combined for Montana near-field receptors is 531 $\mu g/m^3$ compared with a NAAQS of 566 $\mu g/m^3$. The base year maximum predicted impact for 1-hour NO_2 concentrations from all sources combined is 428 $\mu g/m^3$. Thus, predicted future-year impacts represent an increase of 24 percent. For existing Montana CBNG sources, the base year, 1-hour NO_2 concentration impacts would be 122 $\mu g/m^3$ for construction and 200 $\mu g/m^3$ for operation. The maximum predicted impacts would be 118.6 $\mu g/m^3$ and 435 $\mu g/m^3$ for construction and operation, respectively. This indicates a slight decrease in ambient levels as construction declines and an increase of 117 percent from increased well

operation. The predicted 1-hour NO_2 concentration from the TRR is 263 $\mu g/m^3$, which is higher than the change due to combined Montana CBNG construction and operation.

The maximum predicted base year impact to Wyoming near-field receptors for annual NO_2 concentration from all sources combined is 27.2 $\mu g/m^3$. The future predicted impact is 40.7 $\mu g/m^3$, representing an increase of 50 percent. The Wyoming Ambient Air Quality Standards (WAAQS)/NAAQS is 100 $\mu g/m^3$. All modeled source groups' annual NO_2 impacts are below the WAAQS/NAAQS. However, the base year modcled impact exceeds the PSD Class II increment of 25 $\mu g/m^3$. Actual monitoring data for the base year arc significantly lower than base year model results, indicating the conservative nature of the model.

The maximum model predicted base year 24-hour PM_{10} impact to Montana near-field receptors from all sources combined is 30.1 $\mu g/m^3$. The futurc year impact from all combined sources is 45.5 $\mu g/m^3$, or an increase of 51 percent. Again, the base year model results indicate an exceedance of the PSD Class II increment level (30 $\mu g/m^3$), while actual monitored data are well below the PSD increment. The change from base year to future modeled year of 15.4 $\mu g/m^3$ is below the PSD Class II increment level. For existing Montana CBNG sources, the base year predicted impact is 2.91 $\mu g/m^3$ for construction and 2.93 $\mu g/m^3$ for operation. Future modclcd impacts of 3.33 $\mu g/m^3$ and 12.9 $\mu g/m^3$ indicate increases of 14 percent due to construction and 340 percent for operation. The predicted 24-hour PM_{10} impacts from RFFA sources (TRR and Roundup Power Plant) are 1.38 $\mu g/m^3$ and 0.49 $\mu g/m^3$, respectively.

All NEPA analysis comparisons to the PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD incremcnt consumption analysis.

The maximum predicted base year impact to Wyoming near-field receptors for 24-hour PM_{10} concentrations from all sources combined is 89.2 $\mu g/m^3$. The future predicted impact is 105.8 $\mu g/m^3$, representing an increase of 18.6 percent. The WAAQS/NAAQS is 150 $\mu g/m^3$. All modeled source groups' 24-hour PM_{10} impacts are below the WAAQS/NAAQS. However, the base year modeled impact exceeds the PSD Class II increment of 30 $\mu g/m^3$. The change from base year to future modeled year of 16.6 $\mu g/m^3$ is below the PSD Class II increment.

The maximum predicted 24-hour SO_2 concentration for all sources combined for Montana near-field receptors is 15.1 $\mu g/m^3$, compared to an NAAQS of 365 $\mu g/m^3$. The base year maximum predicted impact for 24-hour SO_2 concentration from all sources combined is 15.1 $\mu g/m^3$. Thus, predicted future year impacts represent no change from the base year. For existing Montana CBNG sources, the base year 24-hour SO_2 concentration impacts are 0.45 $\mu g/m^3$ for construction and 0.21 $\mu g/m^3$ for operation. The maximum predicted impacts are 0.56 $\mu g/m^3$ and 0.98 $\mu g/m^3$ for construction and operation, respectively. This indicates a slight change above the base year impacts. The predicted 24-hour SO_2 concentration from the TRR is 3.08 $\mu g/m^3$, which is higher than the change due to combined Montana CBNG construction and operation. The predicted 24-hour SO_2 concentration from the Roundup Power Plant is the same as for Montana CBNG construction.

The maximum predicted base year impacts to Wyoming near-field receptors for 24-hour SO_2 and 3-hour SO_2 concentrations from all sources combined are 124 $\mu g/m^3$ and 552 $\mu g/m^3$. The future predicted impacts are unchanged from the base year. The base year modeled 24-hour SO_2 and 3-hour SO_2 concentration impacts exceed the PSD Class II increments of 91 $\mu g/m^3$ and 512 $\mu g/m^3$.

In addition, Alternative E all sources combined has the potential to exceed the PSD Class I increments for annual NO_2 and 24-hour PM_{10} on the Northern Cheyennc Reservation (see Table 4-24). The far-field analysis indicated a maximum incremcnt level of 3.78 $\mu g/m^3$ for annual NO_2 and 10.9 $\mu g/m^3$ for 24-hour PM_{10}. The annual NO_2 lcvel represents a change from the base year of 3.49 $\mu g/m^3$, which is above the Class I PSD increment. However, the 24-hour PM_{10} change over the base year is 3.57 $\mu g/m^3$, which is lower than the PSD increment. Additionally, the Alternative E all-Montana sources and Montana CBNG operation sources have the potential to exceed the PSD Class I increment for annual NO_2 and 24-hour PM_{10} on the Northern Cheyenne Reservation. The impacts predicted from all Montana sources combined are 3.73 $\mu g/m^3$ for annual NO_2 and 9.73 $\mu g/m^3$ for 24-hour PM_{10}. Montana CBNG operation sources contribute 3.57 $\mu g/m^3$ to annual NO_2 and 9.17 $\mu g/m^3$ to 24-hour PM_{10}. This is because in future year modeling the CBNG resource development for Indian owned land and Forestry Service managed land (RFFAs) was included in the Montana CBNG source group. These high impacts are most likely due to RFFA development within the Northern Cheyenne Reservation and Custer National Forest. The

Fort Peck Reservation indicates a potential to exceed the Class I PSD increment for 24-hour SO_2 of 5 $\mu g/m^3$, with all sources combined having a modeled impact of 7.02 $\mu g/m^3$. The combined "other" source group category, containing mines, refineries and various non-coal or oil and gas related sources, contributes 6.82 $\mu g/m^3$ to this and is unchanged from the base year model. Similarly, Theodore Roosevelt National Park has the potential to exceed the Class I PSD increment for 3-hour and 24-hour SO_2. Again, the other source group contributes over 99 percent to these totals, which are unchanged from the modeled base year.

For Class II areas, the maximum cumulative impact from all combined sources of 45.8 $\mu g/m^3$ on the Crow Reservation exceeds the Class II increment of 30 $\mu g/m^3$ for 24-hour PM_{10}. The Montana coal sources' contribution was predicted to be up to 44.8 $\mu g/m^3$, indicating CBNG sources contributions of 1.0 $\mu g/m^3$ alone.

All NEPA analysis comparisons to the PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD increment consumption analysis.

Given a minimal background ANC level for Upper Frozen Lake within the mandatory federal PSD Class I Bridger Wilderness Area (5.8 µeq/l), the predicted cumulative impact of 2.6 µeq/l change would exceed the threshold level of 1.0 µeq/l. The base year modeled background for Upper Frozen Lake was 2.4 µeq/l, with CBNG related project activities contributing only 0.2 µeq/l to the cumulative impact of 2.6 µeq/l.

Potential visibility impacts were predicted to occur from Alternative E non-project sources alone in every sensitive area analyzed. When Alternative E project and RFFA sources are included in the cumulative analysis, the predicted visibility impacts show an increase of 23 days in the Northern Cheyenne Reservation (see Table 4-25). The maximum Δdv was predicted to be 45.6 at the Bridger Wilderness Area.

For PSD Class II areas, Alternative E Montana project plus RFFA source visibility impacts were predicted to occur in six sensitive areas. Cumulative impacts from Montana CBNG, combined with RFFA sources, added 8 days to the total days of predicted impacts to the Crow Reservation and 2 days to the Cloud Peak Wilderness Area. Non-project sources showed modeled visibility impacts at all Class II sensitive areas, with the maximum of 365 days at the Crow Reservation. The Alternative E Montana CBNG sources, CBNG with RFFA sources and non-project sources visibility impacts for the Class II areas are listed in Table 4-26. The maximum Δdv was predicted to be 57.8 at the Crow Reservation.

TABLE 4-24

ALTERNATIVE E POTENTIAL PSD INCREMENTS EXCEEDANCES

		Contributions ($\mu g/m^3$)				
Location	**Pollutant**	**MT CBNG Only**	**All Sources**	**Base Year All Sources**	**PSD Class I Increment**	**PSD Class II Increment**
Northern Cheyenne Reservation	Annual NO_2	3.57	3.78	0.123	2.5	n/a
	24-hr PM_{10}	9.17	10.9	0.229	8	n/a
Fort Peck Reservation	24-hr SO_2	0.0004	7.02	6.97	5	n/a
Theodore Roosevelt NP	3-hr SO_2	0.0007	36.6	36.5	30	n/a
	24-hr SO_2	0.0002	10.9	10.9	5	n/a
Crow Reservation	24-hr PM_{10}	18.8	45.8	46.7	n/a	30
MT Near Field	24-hr PM_{10}	12.9	45.5	30.6	n/a	30
WY Near Field	Annual NO_2	0.23	40.7	27.2	n/a	25
	24-hr PM_{10}	2.02	106	89.2	n/a	30
	Annual PM_{10}	0.16	19.1	13.5	n/a	17
	3-hr SO_2	0.22	552	552	n/a	512
	24-hr SO_2	0.06	124	124	n/a	91

na=not applicable

TABLE 4-25

ALTERNATIVE E CLASS I AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	Cumulative Total	
Badlands Wilderness Area	0	0	1 to 90	219	23
Bob Marshall Wilderness Area	0	0	1 to 22	28	6
Bridger Wilderness Area	0	0	1 to 70	146	45.6
Fitzpatrick Wilderness Area	0	0	1 to 43	109	31.8
Fort Peck Reservation	1	1	1 to 16	92	16.9
Gates of the Mountains Wilderness Area	0	0	12 to 40	69	11.8
Grand Teton National Park	0	0	2 to 32	92	18.2
Northern Absaroka Wilderness Area	3	3	1 to 34	90	25.6
Northern Cheyenne Reservation	215	238	2 to 59	325	33.8
Red Rock Lakes Wilderness Area	0	0	1 to 19	50	9.4
Scapegoat Wilderness Area	0	0	5 to 31	48	11.3
Teton Wilderness Area	0	0	1 to 32	92	26.8
Theodore Roosevelt National Park	2	2	1 to 32	172	35.6
U.L. Bend Wilderness Area	1	1	5 to 47	99	15.4
Washakie Wilderness Area	3	3	1 to 38	115	36.8
Wind Cave National Park	0	0	1 to 122	262	27.5
Yellowstone National Park	1	1	2 to 38	105	22.6

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

Crow Reservation

Given the proximity of proposed Alternative E emission sources, either near or on the Crow Reservation, it is understandable that air pollutant impacts would occur on tribal lands. All direct, indirect and cumulative impacts were predicted to be in compliance with applicable air quality standards and increments, except the 24-hour PM_{10} Class II increment. Additionally, the following potential visibility impacts were predicted to occur on the Crow Reservation: up to 248 days per year from Alternative E CBNG sources directly; up to 256 days per year from project and RFFA sources combined; up to 359 days per year from non-project sources; and up to 365 days per year from all sources cumulatively. The maximum Δdv was predicted to be 57.8.

Northern Cheyenne Reservation

Given the proximity of proposed Alternative E emission sources, either near or on the Northern Cheyenne Reservation, it is understandable that air pollutant impacts would occur on tribal lands. With the exception of potential Montana CBNG and cumulative source exceedance of the annual NO_2 and 24-hour PM_{10} Class I Increments, all direct, indirect and cumulative impacts were predicted to in compliance with applicable air quality standards and increments. Using Method 6, the following potential visibility impacts were predicted using Method 6 to occur on the Northern Cheyenne Reservation: up to 215 days per year from Alternative E Montana CBNG sources directly; up to 238 days per year from Montana CBNG and RFFA sources combined; up to 59 days per year from non-project sources; and, up to 219 days per year from all

TABLE 4-26

ALTERNATIVE E CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions to Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	Cumulative Total	
Absaroka Beartooth Wilderness Area	4	4	1 to 74	137	30.3
Agate Fossils Bed National Monument	0	1	9 to 9	237	39.9
Bighorn Canyon National Recreation Area	24	24	18 to 74	298	41.1
Black Elk Wilderness Area	0	0	18 to 18	233	27.0
Cloud Peak Wilderness Area	9	11	1 to 29	147	23.9
Crow Reservation	248	256	37 to 359	365	57.8
Devils Tower National Monument	2	2	1 to 20	279	27.8
Fort Belknap Reservation	0	0	5 to 50	92	14.3
Fort Laramie National Historic Site	0	0	7 to 7	249	53.7
Jedediah Smith Wilderness Area	0	0	19 to 19	96	17.4
Jewel Cave National Monument	0	0	19 to 19	252	29.3
Lee Metcalf Wilderness Area	0	0	10 to 79	114	15.3
Mount Naomi Wilderness Area	0	0	1 to 1	52	19.8
Mount Rushmore National Monument	0	0	14 to 14	221	26.2
Popo Agie Wilderness Area	0	0	4 to 14	137	50.2
Soldier Creek Wilderness Area	0	0	11 to 11	245	39.6
Westville Mountain Wilderness Area	0	0	0 to 0	40	16.1
Wind River Reservation	4	4	13 to 35	243	56.6

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

sources cumulatively. The maximum Δdv was predicted to be 23.

Mitigation

Potential mitigation measures to further reduce potential air quality impacts from Alternative E sources would be the same as those presented for Alternative A sources above. Mitigation measures used to reduce potential visibility impacts are discussed under Alternative H in this Chapter.

Alternative F—Phased Development Multiple Screens (High Range)

The potential direct air quality impacts that could occur under this alternative are nearly identical to those predicted under Alternative E. Extensive review of modeling results presented for Alternative E indicates that many predicted impacts come from existing emission sources within the model domain, or are due to RFFA or non-project emissions. Potential near-field (direct, indirect and cumulative) air quality impacts show that, while localized short-term increases in NO_2, SO_2, PM_{10} and $PM_{2.5}$ concentrations could occur, most maximum concentrations are expected to be below applicable state and NAAQS, as well as PSD increments. When compared to base year modeled impacts a few maximum concentrations are predicted to be above applicable state and NAAQS and PSD increments, however, the change from base year to future modeled year is insignificant and considerably below NAAQS and PSD increments. Additionally, the air quality permitting process would be used to analyze emission sources at the project level for CBNG

development and institute any needed mitigation. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

CALPOST Visibility Method 6 was used to predict visibility impacts under Alternative F, which indicated project sources alone would likely have an impact on visibility within four mandatory federal PSD Class I areas. A greater than "just noticeable change" of 1.0 dv was predicted to average up to 3 days per year within the North Absaroka Wilderness Area (maximum 1.4 Δdv), 2 days per year within Theodore Roosevelt National Park (maximum 1.4 Δdv), 3 days per year within the Washakie Wilderness Area (maximum 1.1 Δdv) and 1 day per year within Yellowstone National Park (maximum 1.2 Δdv). Additionally, Alternative F project sources alone were predicted to impact visibility above 1.0 dv for 214 days within the re-designated PSD Class I Northern Cheyenne Reservation (maximum 12.5 Δdv).

Visibility Method 6 was used to predict Alternative F project sources that would impact visibility greater than 1.0 dv on six PSD Class II areas. The model indicated up to 3 days per year within the Absaroka Beartooth Wilderness Area (maximum 3.1 Δdv), 18 days per year within the Bighorn Canyon National Recreation Area (maximum 3.1 Δdv), 8 days per year within the Cloud Peak Wilderness Area (maximum 6.8 Δdv), 115 days per year within the Crow Reservation (maximum 12.9 Δdv), 1 day per year within the Devils Tower National Monument (maximum 1 Δdv) and 3 days per year within the Wind River Reservation (maximum 1.2 Δdv).

Because of the conditions for development within the crucial sage-grouse habitat areas, a lower level of development would likely occur over approximately 93,529 acres (93,529 acres represents 12.8 percent of the potential CBNG development area within the Powder River Basin), which constitutes the area of the four identified crucial sage-grouse habitat areas. This lower level of development could result in an overall reduction of approximately 12.8 percent in CBNG related air emissions and associated impacts. Decreases in CBNG related air emissions and associated impacts would likely be higher within and locally around the four identified crucial sage-grouse habitat areas. The actual decrease in CBNG related air emissions and associated impacts would depend on the level of development that might take place within the four crucial sage-grouse habitat areas.

The modeled impacts from CBNG sources only are shown in Table 4-27.

Temporary Impacts

Temporary impacts for Alternative F are expected to be comparable to those described under Alternative E.

Cumulative Impacts

Given the non-project emission sources located throughout the analysis region, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative F. However, none of the model predicted impacts would exceed state or NAAQS. As discussed for Alternative E and as presented in Table 4-24, impacts for Alternative F could exceed PSD Class I and Class II increments. The impacts that could exceed PSD increments are generally due to existing RFFA or non-project sources, as described under Alternative E. All NEPA analysis comparisons to the PSD increments are intended to evaluate a threshold of concern and do not represent a regulatory PSD increment consumption analysis.

Potential visibility impacts were predicted to occur from Alternative F non-project sources alone in every sensitive area analyzed. Alternative F project and RFFA sources are combined in the cumulative analysis, with the predicted visibility impacts showing a change of an increase of 23 days in the Northern Cheyenne Reservation (see Table 4-28). The maximum Δdv was predicted to be 45.6 at the Bridger Wilderness Area.

For PSD Class II areas, Alternative F Montana project and RFFA source visibility impacts were predicted to occur in six sensitive areas. Cumulative impacts from Montana CBNG combined with RFFA sources added 8 days to the total days of predicted impacts to the Crow Reservation and 2 days to the Cloud Peak Wilderness Area. Non-project sources showed modeled visibility impacts at all Class II sensitive areas, with the maximum of 365 days at the Crow Reservation. The Alternative F Montana CBNG sources, CBNG with RFFA sources and non-project sources visibility impacts for the Class II areas are listed in Table 4-29. The maximum Δdv was predicted to be 57.7 at the Crow Reservation.

Crow Reservation

Alternative F emission sources near or on the Crow Reservation would lead to potential air pollutant

TABLE 4-27

ALTERNATIVE F—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Montana Impacts

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact ($\mu g/m^3$)	MT CBNG (Operation) Modeled Impact ($\mu g/m^3$)	Montana Base Year ($\mu g/m^3$)	PSD Increments[1] ($\mu g/m^3$) Class II	Montana AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	0.26	3.59	3.91	25	100	100
	1-hour	67	435	428	n/a	566	n/a
SO_2	Annual	0.02	0.10	1.71	20	60	80
	24-hour	0.35	0.97	15.1	91	260	365
	3-hour	2.08	4.82	43.9	512	n/a	1,300
	1-hour	6.05	11.51	140	n/a	1,300	n/a
PM_{10}	Annual	0.15	1.43	3.52	17	n/a	n/a
	24-hour	2.03	12.87	30.6	30	150	150
$PM_{2.5}$	Annual	0.01	0.20	0.88	n/a	15	15
	24-hour	0.20	2.16	6.83	n/a	35	35

Wyoming Impacts

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact ($\mu g/m^3$)	MT CBNG (Operation) Modeled Impact ($\mu g/m^3$)	Wyoming Base Year ($\mu g/m^3$)	PSD Increments[1] ($\mu g/m^3$) Class II	Wyoming AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	0.014	0.23	27.2	25	100	100
SO_2	Annual	0.128	1.93	17	20	60	80
	24-hour	0.013	0.15	124	91	260	365
	3-hour	0.054	1.04	552	512	1,300	1,300
PM_{10}	Annual	0.003	0.06	13.5	17	n/a	n/a
	24-hour	0.072	0.22	89.2	30	150	150
$PM_{2.5}$	Annual	0.014	0.06	2.11	n/a	15	15
	24-hour	0.002	0.01	9.4	n/a	35	35

[1] PSD Increment is to be compared to the Montana CBNG Modeled Impact.

n/a – not applicable

TABLE 4-28

ALTERNATIVE F CLASS I AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	Cumulative Total	
Badlands Wilderness Area	0	0	1 to 90	219	23
Bob Marshall Wilderness Area	0	0	1 to 22	28	6
Bridger Wilderness Area	0	0	1 to 70	146	45.6
Fitzpatrick Wilderness Area	0	0	1 to 43	109	31.8
Fort Peck Reservation	0	0	1 to 16	91	16.9
Gates of the Mountain Wilderness Area	0	0	12 to 40	69	11.8
Grand Teton National Park	0	0	2 to 32	92	18.2
Northern Absaroka Wilderness Area	3	3	1 to 34	90	25.5
Northern Cheyenne Reservation	214	237	2 to 59	328	33.8
Red Rock Lakes Wilderness Area	0	0	1 to 19	50	9.4
Scapegoat Wilderness Area	0	0	5 to 31	48	11.3
Teton Wilderness Area	0	0	1 to 32	92	26.7
Theodore Roosevelt National Park	2	2	1 to 32	172	35.6
U.L. Bend Wilderness Area	0	0	5 to 47	97	15.3
Washakie Wilderness Area	3	3	1 to 38	115	36.8
Wind Cave National Park	0	0	1 to 122	262	27.5
Yellowstone National Park	1	1	2 to 38	105	22.5

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

TABLE 4-29

ALTERNATIVE F CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	Cumulative Total	
Absaroka Beartooth Wilderness Area	3	3	1 to 74	137	30.2
Agate Fossils Bed National Monument	0	0	4 to 134	237	39.9
Bighorn Canyon National Recreation Area	18	18	4 to 129	298	40.9
Black Elk Wilderness Area	0	0	1 to 94	233	27
Cloud Peak Wilderness Area	8	10	1 to 52	146	23.9
Crow Reservation	115	123	13 to 359	365	57.7
Devils Tower National Monument	1	1	1 to 97	279	27.8
Fort Belknap Reservation	0	0	5 to 50	92	14.3
Fort Laramie National Historic Site	0	0	1 to 145	249	53.7
Jedediah Smith Wilderness Area	0	0	3 to 31	95	17.4
Jewel Cave National Monument	0	0	1 to 109	252	29.3
Lee Metcalf Wilderness Area	0	0	1 to 79	114	15.2
Mount Naomi Wilderness Area	0	0	1 to 25	52	19.8
Mount Rushmore National Monument	0	0	1 to 91	221	26.2
Popo Agie Wilderness Area	0	0	1 to 66	137	50.2
Soldier Creek Wilderness Area	0	0	4 to 142	245	39.6
Westville Mountain Wilderness Area	0	0	2 to 12	40	16.1
Wind River Reservation	3	3	4 to 96	243	56.5

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

impacts on tribal lands. All direct, indirect and cumulative impacts were predicted to be in compliance with applicable air quality standards and increments, with the exception of the 24-hour PM_{10} PSD Class II increment, which was shown under Alternative E to be due to a coal source and not project-related. Additionally, the following potential visibility impacts were predicted to occur on the Crow Reservation: up to 257 days per year from Alternative F Montana CBNG sources directly, up to 265 days per year from project and RFFA sources combincd, up to 359 days per year from non-project sources and up to 365 days per year from all sources cumulatively. The maximum Δdv was predicted to be 57.8 (Table 4-29).

Northern Cheyenne Reservation

Given the proximity of proposed Alternative F emission sources near or on the Northern Cheyenne Reservation, it is understandable that air pollutant impacts would occur on tribal lands. With the exception of potential project and cumulative source exceedance of the annual NO_2 and 24-hour PM_{10} Class I increments, all direct, indirect and cumulative impacts were predicted to be in compliance with applicable air quality standards and increments. Additionally, the following potential visibility impacts were predicted to occur on the Northern Cheyenne Reservation: up to 214 days per year from Alternative F Montana CBNG sources directly, up to 237 days per year from project and RFFA sources combined, up to 59 days per year from non-project sources and up to 328 days per year from all sources cumulatively. The maximum Δdv was predicted to be 33.8 (Table 4-28).

Mitigation

Potential mitigation measures to further reduce potential air quality impacts from Alternative F sources would be the same as those presented for Alternative A sources above. Mitigation measures that could be used to reduce these potential impacts are discussed under Alternative H in this chapter.Alternative G—Low Range Phased CBNG Development

Potential direct air quality impacts are comparable to Alternative F, but would be reduced by approximately 65 percent (this reduction would not be directly linear due to variables such as photochemistry, well locations, etc.) The air quality permitting process would be used to analyze emission sources at the project level for CBNG development and develop any mitigation needed. Emission sources that would violate standards would not be permitted by the agencies; therefore, residual impacts would remain within standards.

Cumulative Impacts

Given the non-project emission sources located throughout the model domain, there is a potential for cumulative air quality impacts to exceed applicable thresholds under Alternative G. Whilc project-related impacts would be reduced by approximately 65 percent, impacts for Alternative G would still have the potential to exceed PSD Class I and Class II increments. The impacts that havc the potential to exceed PSD increments are generally due to existing, RFFA, or non-project sources, as described undcr Alternative E. As was previously described under Alternative E, base year modeled impacts show the potential to exceed PSD Class I and Class II increments even without considering project emission sources. The existing and non-project emission sources contributing to the base year impacts would be unchanged under Alternative G; thus the potential for exceeding PSD increments would be similar to that described for Alternative E. Additionally, certain RFFAs (TRR and Roundup Power Plant) would be the same under each alternative. Receptors near these emission sources would be affected similarly under each alternative, with project emission sources contributing only a small portion of the total.

Alternative H—Preferred Alternative - Multiple Screens

The potential direct air quality impacts that could occur under Alternative H were modeled using five different scenarios within the SAQA. The results presented here are from scenario 1 which represents the predicted model emissions that would result from the implementation of Alternative H and using current practices for the development of CBNG resources within the PRB of Montana. A review of modeling results indicates that many of the predicted emissions come from existing emission sources within the model domain, or are due to RFFA or non-project emissions. Potential near-field (direct, indirect and cumulative) air quality impacts show that localized short-term increases in NO_2, SO_2, PM_{10} and $PM_{2.5}$ concentrations could occur, but maximum concentrations are predicted to be below applicable state and NAAQS, as well as PSD increments.

Using Visibility Method 6 to predict visibility impacts indicates that Alternative H project sources would not result in a "just noticeable change" to visibility of greater than 1.0 dv at any of the mandatory federal PSD Class I Areas evaluated within the modeling domain. Alternative H project

TABLE 4-30

ALTERNATIVE H (SCENARIO 1)—PROJECT SOURCES CRITERIA POLLUTANT IMPACTS

Montana Impacts

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact ($\mu g/m^3$)	MT CBNG (Operation) Modeled Impact ($\mu g/m^3$)	Montana Base Year ($\mu g/m^3$)	PSD Increments[1] ($\mu g/m^3$) Class II	Montana AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	0.24	1.69	3.91	25	100	100
	1-hour	33.1	251	428	n/a	566	n/a
SO_2	Annual	0.024	0.007	1.71	20	60	80
	24-hour	0.16	0.049	15.1	91	260	365
	3-hour	0.94	0.28	43.9	512	n/a	1,300
	1-hour	3.18	0.94	140	n/a	1,300	n/a
PM_{10}	Annual	0.18	0.43	3.52	17	50	50
	24-hour	1.13	2.9	30.6	30	150	150
$PM_{2.5}$	Annual	0.052	0.21	0.88	n/a	15	15
	24-hour	0.37	1.49	6.83	n/a	65	65

Wyoming Impacts

Pollutant	Averaging Time	MT CBNG (Construction) Modeled Impact ($\mu g/m^3$)	MT CBNG (Operation) Modeled Impact ($\mu g/m^3$)	Wyoming Base Year ($\mu g/m^3$)	PSD Increments[1] ($\mu g/m^3$) Class II	Wyoming AAQS ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	0.048	0.35	27.2	25	100	100
SO_2	Annual	0.005	0.002	17	20	60	80
	24-hour	0.03	0.009	124	91	260	365
	3-hour	0.15	0.04	552	512	1,300	1,300
PM_{10}	Annual	0.047	0.13	13.5	17	50	50
	24-hour	0.28	0.93	89.2	30	150	150
$PM_{2.5}$	Annual	0.017	0.082	2.11	n/a	15	15
	24-hour	0.13	0.69	9.4	n/a	65	65

[1] PSD Increment is to be compared to the Montana CBNG Modeled Impact.

n/a – not applicable

sources were predicted to impact visibility above 1.0 dv for 19 days within the designated PSD Class I Northern Cheyenne Reservation.

Using Visibility Method 6 to predict visibility impacts indicates that Alternative H project sources would result in a "just noticeable change" to visibility of greater than 1.0 dv at four PSD Class II areas. The model results predict one day per year within the Absaroka Beartooth Wilderness Area, four days per year within the Bighorn Canyon National Recreation Area, four days per year within the Cloud Peak Wilderness Area, and 61 days per year within the Crow Reservation.

The modeled impacts from project sources are shown in Table 4-30.

Temporary Impacts

Temporary impacts for Alternative H would be less than those described under Alternative E due to implementation of the provisions within the Air Quality Screen.

Cumulative Impacts

Cumulative impacts under Alternative H (scenario 1) for the Montana near-field receptor grid indicate that there are no exceedances of air quality standards

predicted. The 1-hour NO_2 ambient concentration for the All Montana source group is 539 $\mu g/m^3$ and for the All Sources source group is 540 $\mu g/m^3$. While the standard of 565 $\mu g/m^3$ is not exceeded, the model predicted concentrations are close enough to the standard to indicate that there is a potential for this standard to be exceeded.

Crow Reservation

At the Crow Reservation, all direct, indirect and cumulative impacts are predicted to be below any applicable air quality standards.

Alternative H project sources were predicted to impact visibility above 1.0 dv for 61 days within the PSD Class II Crow Reservation. Up to 165 days of impacted visibility are predicted to occur from CBNG RFFA sources and up to 365 days of impacted visibility are predicted to occur from all sources cumulatively (Table 4-32).

Northern Cheyenne Reservation

At the Northern Cheyenne Reservation, all direct, indirect and cumulative impacts are predicted to be below any applicable air quality standards.

Alternative H project sources were predicted to impact visibility above 1.0 dv for 19 days within the designated PSD Class I Northern Cheyenne Reservation. Up to 136 days of impacted visibility are predicted to occur from CBNG RFFA sources and up to 337 days of impacted visibility are predicted to occur from all sources cumulatively (Table 4-31).

TABLE 4-31

ALTERNATIVE H (SCENARIO 1) - CLASS I AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	All Sources Cumulative Total	
Badlands Wilderness Area	0	0	1 to 90	218	12.5
Bob Marshall Wilderness Area	0	0	1 to 22	28	4.2
Bridger Wilderness Area	0	0	1 to 70	146	15.2
Fitzpatrick Wilderness Area	0	0	1 to 43	109	12.8
Fort Peck Reservation	0	0	1 to 16	90	8
Gates of the Mountains Wilderness Area	0	0	12 to 40	69	9.1
Grand Teton National Park	0	0	2 to 32	92	7.6
Northern Absaroka Wilderness Area	0	0	1 to 34	90	12.5
Northern Cheyenne Reservation	19	136	2 to 59	337	15.5
Red Rock Lakes Wilderness Area	0	0	1 to 19	50	5.3
Scapegoat Wilderness Area	0	0	5 to 31	48	6.7
Teton Wilderness Area	0	0	1 to 32	92	11.9
Theodore Roosevelt National Park	0	0	1 to 32	170	13.6
U.L. Bend Wilderness Area	0	0	5 to 47	98	5.9
Washakie Wilderness Area	0	0	1 to 38	115	15.2
Wind Cave National Park	0	0	1 to 122	260	14.7
Yellowstone National Park	0	0	2 to 38	105	9.6

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

TABLE 4-32

ALTERNATIVE H (SCENARIO 1) - CLASS II AREA POTENTIAL VISIBILITY IMPACTS

Location	Contributions Visibility (No. of days >1.0 dv/yr)				Maximum Δdv
	Montana CBNG Sources Only	Montana CBNG +RFFA Sources	Non-Project Sources	All Sources Cumulative Total	
Absaroka Beartooth Wilderness Area	1	1	1 to 74	136	12.5
Agate Fossils Bed National Monument	0	0	4 to 134	237	13.2
Bighorn Canyon National Recreation Area	4	7	4 to 129	313	63.9
Black Elk Wilderness Area	0	0	1 to 94	232	15
Cloud Peak Wilderness Area	4	4	1 to 52	145	17
Crow Reservation	61	165	13 to 359	365	66.5
Devils Tower National Monument	0	0	1 to 97	278	13.4
Fort Belknap Reservation	0	0	5 to 50	92	5.4
Fort Laramie National Historic Site	0	0	1 to 145	249	14.9
Jedediah Smith Wilderness Area	0	0	3 to 31	95	6.6
Jewel Cave National Monument	0	0	1 to 109	251	14.1
Lee Metcalf Wilderness Area	0	0	1 to 79	112	6.1
Mount Naomi Wilderness Area	0	0	1 to 25	52	7
Mount Rushmore National Monument	0	0	1 to 91	220	14.7
Popo Agie Wilderness Area	0	0	1 to 66	137	16.3
Soldier Creek Wilderness Area	0	0	4 to 142	245	12.5
Westville Mountain Wilderness Area	0	0	2 to 12	40	5.6
Wind River Reservation	0	0	4 to 96	243	2.1

Note: Visibility impacts were determined using Method 6 with monthly f(RH) values

Mitigation

Potential mitigation measures to further reduce possible ambient air quality impacts from Alternative H sources would be the same as those presented for Alternative A sources.

Modeled visibility impacts resulting from project CBNG sources do not show the potential to increase the number of days with visibility impairment to mandatory Class I areas. Modeled visibility impacts resulting from project CBNG sources do show the potential to increase the number of days with visibility impairment at the designated Class I Northern Cheyenne Reservation and at the Class II Crow Reservation. Mitigation measures would be used to minimize these model predicted increases. In addition to the mitigation measures presented below, BLM would work with and assist cooperating agencies to perform visibility modeling studies in conjunction with monitoring conducted under Alternative H. The results of the monitoring and visibility modeling studies would be reviewed by the Air Quality Task Group. The Air Quality Task Group would also work with BLM to identify and select the appropriate party to perform the modeling studies. This might entail operator-funded, third-party contractors; BLM-funded agency or private contractors; or some other combination of funding sources.

Mitigation measures that could be used to reduce potential visibility impacts include the following:

- Reduce source emissions from drilling operations by minimizing the number of well pads through use of improved drilling technologies such as horizontal drilling, or other similar approaches that may become available during the expected CBNG development and operation duration. This would result in decreased emissions of particulate matter from well pad and road

construction during the construction and would reduce particulate matter emissions from travel along roads to well pads during the operation phase.

- Increasing spacing between well pads would cause a decrease in localized ambient impacts as well as reducing far-field effects to an extent.
- Requiring the use of best available control technology (BACT) for certain emission sources, such as compressor engines, would reduce emissions. If BACT alone did not provide sufficient reduction in emissions to avoid visibility impacts, a requirement for the lowest achievable emissions rate (LAER) might become necessary for CBNG development in areas with visibility impact concerns. As an example, LAER for compressors could involve use of electric powered compressor engines.
- Use of alternate fuels such as low sulfur and low nitrogen content fuels would minimize NO_x and SO_2 formation.
- Alternative H has a feedback loop where the effectiveness of each mitigation measure, or set of measures, is quantified through monitoring and modeling. As monitoring and modeling results become available, BLM might adopt more stringent measures to avoid predicted air quality impacts. BLM would provide CBNG operators with a target of no exceedances of ambient air quality standards and a list of possible mitigation measures to minimize impacts to visibility. Operators would then design projects with selected mitigation measures. Alternative H's adaptive management approach would allow BLM to accept the proposals and retroactively apply successful mitigation measures to existing projects, as needed. While DEQ would play a lead role in ongoing air quality monitoring and modeling, BLM would support it in performing any additional work that might be required to meet Alternative H objectives of no exceedances.

The following mitigation measures were discussed in Chapter 2 as part of the description of the Air Quality Screen of Alternative H.

- The number of wells connected to each compressor would be maximized and natural-gas-fired or electrical compressors or generators would be required.
- To reduce dust, operators of federal leases would have to post and enforce speed limits for their employees and contractors. Operators could work with local government to use dust suppression techniques on roads. See additional mitigation measures in the Air Quality and Climate Appendix.
- If subsequent visibility modeling conducted as part of the air screen indicates unacceptable impacts would occur at a future point in the PRB development, modeling would then include mitigation scenarios that would investigate mitigation measures. Mitigation efforts would focus on compressor motors and the extent of operating compressors because it appears that gas-fired compressor motors account for approximately 90% of the overall project emissions and visibility impacts.

Supplemental Air Quality Analysis

The air analysis conducted for the DSEIS showed the potential for CBNG project-related activities to have an impact on air quality (particularly to visibility) at certain Class I areas within the planning area, including the Northern Cheyenne Reservation. The Supplemental Air Quality Analysis (SAQA) was conducted to determine at what level CBNG project-related development would have an impact on visibility at the Northern Cheyenne Reservation, as well as on other Class I areas within the planning area and to modify the preferred alternative to include monitoring, mitigation and avoidance of those potential impacts.

The SAQA contains data on five scenarios that were modeled for the planning area. The revised Alternative H scenario was modeled to better determine the direct impacts to air quality from project-related CBNG development. The first and second scenarios are modifications that reflect the differences in how current CBNG development is conducted within the Montana portion of the Powder River Basin versus what was predicted in the DSEIS. Two additional mitigation scenarios were modeled with data presented on impacts resulting from reduced compression requirements for project CBNG development under the first and second scenarios.

The SAQA also contains a modification to the preferred alternative to allow for monitoring, mitigation and avoidance of the potential impacts to

air quality within the planning area. These changes are included in the preferred alternative.

The data contained within the SAQA are intended to augment information in the DSEIS, not replace it.

Project-related emissions include those from CBNG construction and operations activities in Montana. The scenarios presented within the SAQA were analyzed to achieve the following:

- Assess project-related versus non-project-related CBNG emissions under Revised Alternative H.
- Assess emissions associated with compressor operations using different NO_X emissions factors and adjusting well to field to sales compressor ratios to more accurately represent current practice within the Montana portion of the PRB under scenarios 1 and 2.
- Assess the level at which project-related CBNG emissions would have to be reduced to achieve zero days of impacts to visibility at the PSD Class I areas under scenarios 1A and 2A.

The DSEIS evaluated potential emissions from Coal Bed Natural Gas (CBNG) related activities by combining project related CBNG development, as outlined in the Reasonably Foreseeable Development (RFD) scenario, with non-project related CBNG development on the Crow and Northern Cheyenne reservations, as outlined in the Reasonably Foreseeable Future Actions (RFFA) scenario, into one emissions source group. The SAQA evaluates these two emissions groups separately to allow for the determination of potential air quality impacts that result directly from project related CBNG activities. Also included are potential air quality impacts from emission sources in Montana (All Montana Source Group), which includes project related CNBG emissions, and cumulative emissions (All Source Group) which includes all emissions sources both project related and non-project related. Information on the potential air quality impacts from specific source groups is contained within Appendix C of the SAQA document. Additionally, emission points representing potential emissions from CBNG construction, operations, and maintenance activities were decentralized within each watershed to better represent actual development conditions. The adjustments to emission point locations and the separation of RFD and RFFA CBNG wells were applied to each of the supplemental scenarios analyzed which are described below. Emission factors used were derived from the air quality modeling analyses conducted for the Statewide Document (BLM, 2003) conducted by Argonne National Laboratories (Argonne 2002). The air modeling analysis was conducted to separate project RFD emissions from non-project RFFA emissions; decentralize the project RFD and non-project RFFA emission source points; and utilize a well to field compressor to sales compressor ratio of 240 wells connected to 10 field compressors connected to 1 sales compressor (240:10:1) with a NO_X emissions factor for compressors of 1.5 grams per brake horsepower-hour (1.5 g/bhp-hr). This scenario is referred to in the SAQA document as Alternative H Revised.

Current CBNG development within the Montana portion of the Powder River Basin (PRB) is conducted using a ratio of 200 wells connected to 5 field compressors connected to 1 sales compressor. The SAQA includes an air modeling analysis scenario which uses this ratio of 200:5:1 and a NO_X emissions factor for compressors of 1.5 g/bhp-hr for project RFD wells; the well to field compressor to sales compressor ratio for non-project RFFA wells was not adjusted. This scenario is referred to as scenario 1.

The SAQA also evaluates an air modeling analysis scenario (scenario 2) using the 200:5:1 well to field compressor to sales compressor ratio and the NO_X emissions factor of 1.0 g/bhp-hr for project RFD wells; the NO_X emissions factor for non-project RFFA wells was not adjusted. The 1.0 g/bhp-hr NOx emission factor was selected for scenario 2 to reflect an emission level permitted by the Montana Department of Environmental Quality (MDEQ) for certain CBNG compressors within the PRB. scenarios 1 and 2 utilize the same number of operating CBNG wells but would have varying compressor and horsepower requirements and subsequent emissions output related to compressor operations. The lowering of the NO_X emissions factor to reflect some MDEQ permitting levels for scenario 2 would further reduce the emissions associated with scenario 1.

The SAQA evaluates a mitigation scenario (scenario 1A) which assumes a 50% reduction applied to scenario 1 compressor horsepower requirements. This scenario reduces compressor operations emissions and associated maintenance emissions by 50% but leaves all other emissions the same as previously modeled for scenario 1. The effect of this assumption reduces calculated compressor emissions by 50% for NO_X, SO_2, PM_{10}, and $PM_{2.5}$.

The SAQA evaluates a second air quality mitigation scenario (scenario 2A) which assumes a 50% reduction applied to the scenario 2 compressor horsepower requirements. This scenario reduces

compressor operations emissions and associated maintenance emissions by 50% but leaves all other emissions the same as previously modeled for scenario 2. The effect of this assumption reduces calculated compressor emissions by 50% for NO_X, SO_2, PM_{10}, and $PM_{2.5}$.

The SAQA also includes revised emissions data for the Tongue River Railroad (TRR) which was reconfigured to better simulate a linear emission source. The total emissions for the TRR were kept constant and are the same as presented in the AQTSD; however, the number of emission points representing the TRR alignment was increased from 20 to 96.

Project related emissions include emissions from CBNG construction and operations activities in Montana. The five scenarios presented were analyzed to assess project related versus non-project related CBNG emissions under Revised Alternative H, assess emissions associated with compressor operations utilizing different NO_X emissions factors and adjusting well to field to sales compressor ratios to more accurately represents current practice within the Montana portion of the PRB under scenarios 1 and 2, and assess at what level project related CBNG emissions would need to be reduced to achieve zero days of impacts to visibility at the Prevention of Significant Deterioration (PSD) Class I areas under scenarios 1A and 2A.

The SAQA analyses used the CALMET and CALPUFF models to assess the potential for impacts from project-related and non-project-related cumulative air emissions of PM_{10}, $PM_{2.5}$, NO_X, and SO_2 on air quality and air quality related values at near-field receptor locations within the PRB and far-field receptor locations within the modeling domain.

Far-field receptor locations consist of PSD Class I and Class II areas. Results of these analyses show that project-related CBNG activities would not have the potential to exceed NAAQS or MAAQS for NO_2, PM_{10}, $PM_{2.5}$, or SO_2 under any of the scenarios evaluated at either near-field or far-field receptors or NO_2, PM_{10}, or SO_2 PSD increments.

Visibility impacts to Class I and Class II areas were evaluated using the Federal Land Managers Air Quality Related Values Workgroup (FLAG) Method 2 and the Regional Haze Rule Method 6. Method 6 Results are presented as consistent with the Best Available Retrofit Technique (BART) guideline. Using Method 6, visibility impacts were evaluated for select Class I and Class II areas within the modeling domain. Visibility impacts were evaluated for the designated Class I Northern Cheyenne Reservation because of its proximity to proposed development. Using Method 6, visibility impacts to the Northern Cheyenne Reservation consisted of 19 days for scenario 1, zero days for scenario 1A, 7 days for scenario 2 and zero days of visibility impacts under scenario 2A. As a result, BLM modified the Air Quality Screen for Alternative H to more proactively track development and assess potential impacts relative to CBNG project-related development to mitigate potential visibility impacts before any days of visibility impacts would occur from project-related development to nearby Class I areas; in particular the Northern Cheyenne Reservation.

Climate Change

Introduction

The assessment of greenhouse gas (GHG) emissions and climate is an ongoing scientific endeavor. Oil and gas development is likely to contribute to future emissions of GHGs to the atmosphere. However, while it's generally accepted that human activities are changing the composition of Earth's atmosphere; important scientific questions remain about how much warming will occur, how fast it will occur, and how warming will affect the rest of the climate system including temperatures, precipitation patterns and storms. Additionally, while oil and gas development may contribute emissions of GHGs, the amount of any contribution cannot be compared to any regulatory standards because there are no applicable Federal or State standards at this time. It has been noted that "[t]o date, many of the models needed to make effective decisions at the local and regional levels have not been developed" (DOI, 2007). According to the USGS (2008) "It is currently beyond the scope of existing science to identify a specific source of CO_2 emissions and designate it as the cause of specific climate impacts…". The EPA has noted that "Answering these questions will require advances in scientific knowledge in a number of areas:

- Improving understanding of natural climatic variations, changes in the sun's energy, land-use changes, the warming or cooling effects of pollutant aerosols, and the impacts of changing humidity and cloud cover.
- Determining the relative contribution to climate change of human activities and natural causes.
- Projecting future greenhouse emissions and how the climate system will respond within a narrow range.

- Improving understanding of the potential for rapid or abrupt climate change.

Addressing these and other areas of scientific uncertainty is a major priority of the U.S. Climate Change Science Program (CCSP)." (EPA, 2007; http://www.epa.gov/climatechange/science/stateofknowledge.html#ref).

Given these analysis limitations, accounting and disclosure of potential GHG emissions is the preferred option at this time. A comparison between project emissions and total State, U.S. and global emissions is provided on Table 4-CC-3.

This analysis focuses on GHG emissions from CBNG development. The development of CBNG in Montana is not anticipated to noticeably affect sinks of GHGs, and the feasibility of CBNG development is not anticipated to be affected by global climatic change.

Five scenarios were evaluated for GHG emissions from CBNG development in Montana. These are No Action (Alternative A), high RFD with no screens (Alternatives B, C, D and E), high RFD with restrictive screens (Alternative F), low RFD with restrictive screens (Alternative G), and high RFD with less restrictive screens (Alternative H).

Sources of CO_2 from the project include emissions from construction activities, operations, and maintenance. The emissions for each type of source were discretely determined for Alternatives B, C, D and E which were based on the high RFD with no screens (see table 4-CC-1). For other alternatives the emissions were proportioned based upon the ratio of gas anticipated to be produced in each alternative relative to the high RFD with no screens (see Table 4-CC-2).

The EPA has noted that "[t]he U.S. natural gas system encompasses hundreds of thousands of wells, hundreds of processing facilities, and over a million miles of transmission and distribution pipeline. All industry sectors, including gas production, processing, transmission, and distribution emit methane to the atmosphere to varying degrees. Methane emissions are generally process-related, with normal operations, routine maintenance, and system upsets being the primary contributors" (EPA, 2007b). The amount of methane (CH_4) that is emitted relative to the amount of gas produced was calculated by using Energy Information Administration (EIA) estimates of US total methane emissions from natural gas systems (EIA, 2007) from 1995 to 2006, plotted against EIA data for the gross withdrawal of natural gas (EIA, 2008). EIA methane emission data (EIA, 2007) also allows for the estimation of the likely sources of methane emissions, with emissions from production and processing accounting for 37.9% of methane emissions from natural gas systems. This allows for the calculation of an emission factor of 2.36 million metric tones (MMT) carbon dioxide equivalent (CO_2e) of methane per trillion cubic feet (TCF) of gas produced.

The adoption of the EPA's Gas STAR BMPs is not a part of any of the alternatives, and it is a voluntary program; however if these practices were employed it would reduce the volume of methane emitted per TCF of gas and emissions would be less than reported from this analysis. By following these practices the EPA has reported reductions of 85.9 BCF of emissions for 2006 (the latest year figures were available for). EPA estimates that this is the equivalent of removing approximately 7.5 million cars from the road for the year.

Calculated CH_4 emission values are combined with the CO_2 emissions values to give a total GHG emission value for each alternative in terms of CO_2e. These resulting values are divided by 40 to give an average annual emission rate. This annual emission rate is then compared to existing (2004 & 2005) and projected statewide, nationwide and global emissions values (see Table 4-CC-3).

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

There would be no additional contribution to atmospheric CO_2e levels from the development of CBNG in Montana under this alternative. See Tables 4-CC-2 and 4-CC-3 for CO_2e emissions that are projected result with no additional CBNG development in Montana.

Alternatives B, C, D, & E

Construction activities, operations, and maintenance would result in CO_2 emissions. CO_2 emissions over the 40 year life of the project would be approximately 45.9 MMT (see Table 4-CC-1). Emissions of methane are anticipated to equal approximately 11.8 MMT in CO_2 equivalents (CO_2e) over the life of the project. These emissions combine to contribute 57.7 MMT of CO_2e over the 40 year life of the project (see Table 4-CC-2); or an average of 1.44 MMT of CO_2e per year. According to the EPA's online calculator (EPA, 2008c; http://www.epa.gov/cleanenergy/energy-

resources/calculator.html) this average annual rate would be approximately equivalent to the annual greenhouse gas emissions from 264,000 passenger vehicles, or the annual CO_2 emissions of 0.3 coal fired power plants.

The CCS conducted an inventory of GHG emissions in the State of Montana for 2005 (CCS, 2007). These values indicate that CBNG development under these alternatives would add approximately 3.9% to the State's emissions (see Table 4-CC-3).

Data from the EIA (2007) and the EPA (2006) can be used to estimate total 2005 U.S. GHG emissions and total 2004 global GHG emissions. In these contexts the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.020% and a 0.0039% increase respectively (see Table 4-CC-3).

Cumulative Impacts:

The cumulative impact of the GHG emissions from the SEIS decisions (CBNG development) together with other activities with GHG emissions that have occurred, are occurring or are reasonably foreseeable are set forth herein. Assuming there are other GHG emitting activities that have, are, or will occur, the impacts of those activities, together with this Amendment's activities could result in certain climatic changes.

Montana emissions projections for 2010 and 2020 are also available from the CCS GHG Inventory (2007). These projections "are based on a compilation of various existing projections of electricity generation, fuel use, and other GHG emitting activities" (CCS, 2007) and as such it incorporates all past present and reasonably foreseeable GHG emitting activities in the State. The reference case scenario "[a]ssumes very limited CBM activity". Therefore, this scenario is comparable to that assumed for Alternative A (Existing Management), and is used as the baseline for this analysis. Based upon these values CBNG development under these alternatives would add approximately 3.7% to the State's emissions in 2010 and 3.5% to the State's emissions in 2020 (see Table 4-CC-3).

Using data from the EIA (2007) and the EPA (2006) the U.S. and global GHG emissions can be projected for 2010 and 2020. These projections incorporate all past present and reasonably foreseeable GHG emitting activities. Relative to the U.S. values for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.019% and a 0.017% increase respectively. Relative to the global data for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.0034% and a 0.0029% increase respectively.

The EPA has evaluated the likely cumulative impacts from increased atmospheric CO_2 levels for the mountain west (EPA Region 8; EPA 2008a; http://www.epa.gov/region8/climatechange/ClimateChange101FINAL.pdf). This evaluation is included by reference here. This analysis indicates that "In the coming decades, scientists project that climate change will lead to significant changes in the Mountain West and Great Plains". The mid-range of the IPCC is for a change of 5.4°F. This is enough to make Missoula as warm as Denver is now.

At a broader level the EPA has evaluated a variety of potential national and global impacts from climate change (EPA 2007b; www.epa.gov/climatechange/effects/index.html). This evaluation is included by reference here. These impacts include an increase in average temperature, shrinking of glaciers, thawing of permafrost, later freezing and earlier break-up of ice on rivers and lakes, lengthening of growing seasons, shifts in plant and animal ranges and earlier flowering of trees. Human health, agriculture, natural ecosystems, coastal areas, and heating and cooling requirements are examples of systems that are sensitive to climate change.

Additional discussions of the various types of impacts that can be expected from climate change are available at the EPA's Climate Change website (www.epa.gov/climatechange) (EPA, 2008c).

According to the Intergovernmental Panel on Climate Change (IPCC, 2007) global climate change may ultimately contribute to a rise in sea level, destruction of estuaries and coastal wetlands, and changes in regional temperature and rainfall patterns, with major implications to agricultural and coastal communities. The IPCC has suggested that the average global surface temperature could rise 1 to 4.5 degrees Fahrenheit (°F) in the next 50 years, with significant regional variation. The National Academy of Sciences (2008) has confirmed these estimates, but also indicated that there are uncertainties regarding how climate change may affect different regions. Computer models indicate that such increases in temperature will not be equally distributed globally, but are likely to be accentuated at higher latitudes, such as in the Arctic, where the temperature increase may be more than double the global average (BLM 2007). Also, warming during the winter months is expected to be greater than during the summer, and increases in daily minimum temperatures is more

TABLE 4-CC-1:

PROJECTED CO_2 EMISSIONS FROM CBNG DEVELOPMENT BASED ON THE RFD FOR ALTERNATIVES B, C, D, AND E

Emission Source	CO_2 (MMT)	% of total
Construction Emissions		
Heavy Equipment	0.64	1.4%
Commuting Vehicles	0.01	0.02%
Total Construction	**0.65**	**1.42%**
Operations Emissions		
Compressor Stations		
Field Compressors	9.87	21.5%
Sales Compressors	34.80	75.9%
Dehydrators	0.49	1.1%
Commuting Vehicles	0.0001	0.0003%
Wells		
Workovers - On-site	0.04	0.08%
Workovers - On-road	0.001	0.003%
Well and Pipeline Inspections	0.001	0.003%
Total Operations	**45.20**	**98.55%**
Maintenance Emissions		
Road Maintenance		
Heavy Equipment	0.01	0.03%
Commuting Vehicles	0.0001	0.0002%
Compressor Station Maintenance		
Commuting Vehicles	0.0002	0.000%
Total Maintenance	**0.014**	**0.03%**
TOTAL CO_2 EMISSIONS	***45.9***	

(Well:Field:Sales = 200:5:1)

TABLE 4-CC-2:

PROJECTED CBNG CO_2 AND CH_4 EMISSIONS BY ALTERNATIVE OVER THE LIFE OF THE PROJECT

Alternative	Estimated CO_2 Emissions (MMT CO_2e)	Estimated CH_4 Emissions (MMT CO_2e)	Total Estimated Emissions (MMT CO_2e)
Alt A	0.0	0.0	0.0
Alts B,C,D & E	45.9	11.8	57.7
Alt F	25.7	6.6	32.3
Alt G	9.2	2.4	11.5
Alt H	31.2	8.0	39.2

MMT = Millions of Metric Tons
CO_2e = Carbon Dioxide Equivalent

likely than increases in daily maximum temperatures. Vulnerabilities to climate change depend considerably on specific geographic and social contexts.

Alternative F—Phased Development Multiple Screens (High Range)

Construction activities, operations, and maintenance would result in CO_2 emissions. CO_2 emissions over the 40 year life of the project would be approximately 25.7 MMT. Emissions of methane are anticipated to equal approximately 6.6 MMT in CO_2e over the life of the project. These emissions combine to contribute 32.3 MMT of CO_2e over the 40 year life of the project (see Table 4-CC-2); or an average of 0.81 MMT of CO_2e per year. According to the EPA's online calculator (EPA, 2008b; http://www.epa.gov/cleanenergy/energy-resources/calculator.html) this average annual rate would be approximately equivalent to the annual greenhouse gas emissions from 148,000 passenger vehicles, or the annual CO_2 emissions of 0.2 coal fired power plants.

The Center for Climate Strategies conducted an inventory of GHG emissions in the State of Montana for 2005 (CCS, 2007). These values indicate that CBNG development would add approximately 2.2% to the State's emissions under this alternative (see Table 4-CC-3).

Data from the EIA (2007) and the EPA (2006) can be used to estimate total 2005 U.S. GHG emissions and total 2004 global GHG emissions. In these contexts the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.011% and a 0.0022% increase respectively (see Table 4-CC-3).

Cumulative Impacts:

Based upon the CCS GHG Inventory (2007) CBNG development under this alternative would add approximately 2.1% to the State's emissions in 2010 and 1.9% to the State's emissions in 2020 (see Table 4-CC-3).

Using data from the EIA (2007) and the EPA (2006) the U.S. and global GHG emissions can be projected for 2010 and 2020. Relative to the U.S. values for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.011% and a 0.010% increase respectively. Relative to the global data for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.0019% and a 0.0016% increase respectively (see Table 4-CC-3).

TABLE 4-CC-3:
COMPARISON OF MONTANA, U.S. AND GLOBAL CO_2E EMISSIONS & PROJECTIONS TO CO_2E EMISSIONS PROJECTED FOR CBNG DEVELOPMENT IN MONTANA

			MMT of Emissions per Year		
			Existing*	Projected	
			(2004/2005)	2010	2020
Alternative A	Montana[1]	MMT CO_2e	36.8	38.5	41.7
	U.S.[2]	MMT CO_2e	7,181	7,405	8,275
	Global[2]	MMT CO_2e	36,510	41,851	49,750
Alternatives B,C,D & E	Montana	MMT CO_2e	38.2	39.9	43.1
		% diff[+]	3.9%	3.7%	3.5%
	U.S.	MMT CO_2e	7,182	7,406	8,276
		% diff[+]	0.020%	0.019%	0.017%
	Global	MMT CO_2e	36,511	41,852	49,751
		% diff[+]	0.0039%	0.0034%	0.0029%
Alternative F	Montana	MMT CO_2e	37.6	39.3	42.5
		% diff[+]	2.2%	2.1%	1.9%
	U.S.	MMT CO_2e	7,182	7,406	8,275
		% diff[+]	0.011%	0.011%	0.010%
	Global	MMT CO_2e	36,511	41,852	49,751
		% diff[+]	0.0022%	0.0019%	0.0016%
Alternative G	Montana	MMT CO_2e	37.1	38.8	42.0
		% diff[+]	0.8%	0.7%	0.7%
	U.S.	MMT CO_2e	7,181	7,405	8,275
		% diff[+]	0.004%	0.004%	0.003%
	Global	MMT CO_2e	36,510	41,851	49,750
		% diff[+]	0.0008%	0.0007%	0.0006%
Alternative H	Montana	MMT CO_2e	37.8	39.5	42.7
		% diff[+]	2.7%	2.5%	2.4%
	U.S.	MMT CO_2e	7,182	7,406	8,276
		% diff[+]	0.014%	0.013%	0.012%
	Global	MMT CO_2e	36,511	41,852	49,751
		% diff[+]	0.0027%	0.0023%	0.0020%

* Values for Montana and the U.S. are for 2005, global values are for 2004.
1 = CSC, 2007
2 = EIA, 2007 and EPA, 2006
MMT = Millions of Metric Tons
CO_2e = Carbon Dioxide Equivalent
[+] % difference from the No Action

The likely cumulative climatic impacts from increased atmospheric CO_2e levels would not be measurably different from those described for alternatives B, C, D and E.

Alternative G—Phased Development Multiple Screens (Low Range)

Construction activities, operations, and maintenance would result in CO_2 emissions. CO_2 emissions over the 40 year life of the project would be approximately 9.2 MMT. Emissions of methane are anticipated to equal approximately 2.4 MMT in CO_2e over the life of the project. These emissions combine to contribute 11.5 MMT of CO_2e over the 40 year life of the project (see Table 4-CC-2); or an average of 0.29 MMT of CO_2e per year. According to the EPA's online calculator (EPA, 2008b; http://www.epa.gov/cleanenergy/energy-resources/calculator.html) this average annual rate would be approximately equivalent to the annual greenhouse gas emissions from 53,000 passenger vehicles, or the annual CO_2 emissions of 0.1 coal fired power plants.

The Center for Climate Strategies has conducted an inventory of GHG emissions in the State of Montana for 2005 (CCS, 2007). These values indicate that CBNG development would add approximately 0.8% to the State's emissions under this alternative (see Table 4-CC-3).

Data from the EIA (2007) and the EPA (2006) can be used to estimate total 2005 U.S. GHG emissions and total 2004 global GHG emissions. In these contexts the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.004% and a 0.0008% increase respectively (see Table 4-CC-3).

Cumulative Impacts:

Based upon the CCS GHG Inventory (2007) CBNG development under this alternative would add approximately 0.7% to the State's emissions in 2010 and 0.7% to the State's emissions in 2020 (see Table 4-CC-3).

Using data from the EIA (2007) and the EPA (2006) the U.S. and global GHG emissions can be projected for 2010 and 2020. Relative to the U.S. values for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.004% and a 0.003% increase respectively. Relative to the global data for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.0007% and a 0.0006% increase respectively.

The likely cumulative climatic impacts from increased atmospheric CO_2e levels would not be measurably different from those described for alternatives B, C, D and E.

Alternative H—Preferred Alternative - Multiple Screens

Construction activities, operations, and maintenance would result in CO_2 emissions. CO_2 emissions over the 40 year life of the project would be approximately 31.2 MMT. Emissions of methane are anticipated to equal approximately 8.0 MMT in CO_2e over the life of the project. These emissions combine to contribute 39.2 MMT of CO_2e over the 40 year life of the project (see Table 4-CC-2); or an average of 0.98 MMT of CO_2e per year. According to the EPA's online calculator (EPA, 2008b; http://www.epa.gov/cleanenergy/energy-resources/calculator.html) this average annual rate would be approximately equivalent to the annual greenhouse gas emissions from 179,000 passenger vehicles, or the annual CO_2 emissions of 0.2 coal fired power plants.

The Center for Climate Strategies conducted an inventory of GHG emissions in the State of Montana for 2005 (CCS, 2007). These values indicate that CBNG development would add approximately 2.7% to the State's emissions under this alternative (see Table 4-CC-3).

Data from the EIA (2007) and the EPA (2006) can be used to estimate total 2005 U.S. GHG emissions and total 2004 global GHG emissions. In these contexts the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.014% and a 0.0027% increase respectively (see Table 4-CC-3).

Cumulative Impacts:

Based upon the CCS GHG Inventory (2007) CBNG development under this alternative would add approximately 2.5% to the State's emissions in 2010 and 2.4% to the State's emissions in 2020 (see Table 4-CC-3).

Using data from the EIA (2007) and the EPA (2006) the U.S. and global GHG emissions can be projected for 2010 and 2020. Relative to the U.S. values for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under this alternative would cause a 0.013% and a 0.012% increase respectively. Relative to the global data for 2010 and 2020 the annual emissions of GHGs from CBNG development in Montana under these alternatives would cause a 0.0023% and a 0.0020% increase respectively.

The likely cumulative climatic impacts from increased atmospheric CO_2e levels would not be measurably different from those described for alternatives B, C, D and E.

Cultural Resources

Cultural Resources *Approximately 73,600 cultural resource sites exist above known coal resources within the CBNG emphasis area*
Alternative A **No Action (Existing CBNG Management)**
• An estimated 17 cultural resource sites could be identified during foreseen CBNG activities. Of these only one or two would likely be eligible or need additional work to evaluate eligibility for the NRHP. • Cumulative Impacts: – An estimated 4,285 cultural sites could be identified resulting in 430 to 612 sites that could be eligible for the NRHP.
Alternatives B, C and D
• The number of cultural resource sites identified would be practically the same for Alternatives B, C and D based on the level of development, associated area of disturbance and minor differences between the alternative realty management actions. An estimated 630 cultural resource sites could be identified. • Cumulative Impacts: – An estimated 5,135 cultural sites could be identified. Of these between 514 and 734 sites would likely be eligible or need additional work to evaluate eligibility for the NRHP. – Potential for impacts to TCPs would increase with the development of CBNG.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• An estimated 893 to 1,080 cultural resource sites could be identified. • Cumulative Impacts: – An estimated 5,398 to 5,585 cultural sites could be identified. Of these between 540 and 798 sites would likely be eligible or need additional work to evaluate eligibility for the NRHP. – Potential for impacts to TCPs would increase with the development of CBNG.
Alternative F **Phased Development Multiple Screens (High Range)**
• The number of cultural resource sites identified would be similar to Alternative E. • An estimated 893 to 1,080 cultural resource sites could be identified. • Should no drilling occur within crucial sage-grouse habitat, the number of cultural resources sites that could be identified would be reduced by 12.8 percent. • Cumulative Impacts: – An estimated 5,398 to 5,585 cultural sites could be identified. Of these between 540 and 798 sites would likely be eligible or need additional work to evaluate eligibility for the NRHP. – The potential for impacts to TCPs would increase with the development of CBNG. – Should no drilling occur within crucial sage-grouse habitat, the cumulative number of cultural resources sites that could be identified would be reduced from 5,447 to 5,284.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to those for Alternative F, except that expected impacts to cultural resource sites would be reduced by approximately 65 percent due to fewer federal applications for permit to drill (APDs) being issued. • An estimated 312 to 378 cultural resource sites could be identified based on the reduced number of federal APDs being issued. • Cumulative Impacts: • An estimated 4,817 to 4,883 cultural sites could be identified based on the reduced number of federal APDs being issued. Of these between 482 and 698 sites would likely be eligible or need additional work to evaluate eligibility for the National register of Historic Places (NRHP). • Potential for impacts to TCPs would be similar to Alternative F, but would be reduced by approximately 65 percent based on the reduced number of federal APDs being issued.
Alternative H **Preferred Alternative - Multiple Screens**
• The number of cultural resource sites identified would be similar to those for Alternatives E and F. • Should no drilling occur within crucial sage-grouse habitat, the number of cultural resources sites that could be identified would be reduced by 12.8 percent • An estimated 893 to 1080 cultural resource sites could be identified. • Cumulative Impacts: • An estimated 5,398 to 5,585 cultural sites could be identified. Of these between 540 and 798 sites would likely be eligible or need additional work to evaluate eligibility for the NRHP. • Potential for impacts to TCPs would increase with the development of CBNG.

Assumptions

Cultural resources would be treated similarly and equally in terms of type, composition and significance; their distributions and densities are detailed in Chapter 3. Cultural resources are treated in this manner only for purposes of evaluation in this report, since the particular cultural resources to be affected are not necessarily known at this time. It must be understood that not all cultural resources are equal in terms of importance, National Register eligibility, density and location. Federally recognized tribes will need to be consulted, consistent with the requirements of the National Historic Preservation Act (NHPA) and regulations found at 36 Code of Federal Regulations (CFR) Part 800. Most of the mitigation for Native American cultural resources

will entail avoidance, particularly any site associated with burials of human remains. Cultural resource attributes will have to be taken into consideration when impacts are considered for each individual CBNG development. Operators will need to develop an approach for mitigating cultural resources based on the plan for CBNG development that they submit. The Cultural Resource section of that plan will need to include the following guidelines in BLM's 8100 Manual Series, the Secretary of the Interior's Standards and Guidelines For Archaeology and Historic Preservation (FR 48 (190)44716-44742, 1983) and the Advisory Council on Historic Preservation's document the "Treatment of Archaeological Properties" (ACHP 1980)

Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. There would be one site for every 100 acres surveyed for cultural resources. This assumption was made by averaging the number of sites vs. acres surveyed in the Planning Area from existing surveys. This estimate is based on surveys that covered 19 percent of the estimated CBNG development area. The actual number of cultural resources in a particular CBNG development field could vary dramatically depending on the exact location of the field.

Impacts from Management Common To All Alternatives

Cultural resources would be impacted by surface and subsurface disturbing activities. Activities that involve the use of heavy equipment (road construction, well drilling, pad construction, pipeline and utility placement, etc.) that result in changes to the natural landscape could cause the most disturbance and could have the greatest effect on cultural resources. Other activities, such as increased travel and vandalism resulting from access improvements and increased erosion resulting from surface disturbances, would also impact cultural resources. These activities can also produce indirect impacts to cultural resources from fires; and to rock art sites from gas emissions, abrasive dust and vibrations from drilling equipment. Noise, activity, traffic and smells can affect the quality and continued use of Traditional Cultural Properties (TCPs). Traditional Cultural Properties important to the Northern Cheyenne and Crow and their perceptions of mitigation are presented in The Northern Cheyenne Tribe and its Reservation: 2002 (The Northern Cheyenne Tribe 2002), Crow Reservation (Crow Tribe of Indians 2002) and An Ethnographic Overview of Southeast Montana (Peterson and Deaver 2002).

Impacts would occur at an estimated 318 cultural resource sites. Of these sites, 32 to 46 are projected to be eligible for the National Register of Historic Places. The estimated number of sites includes 176 cultural resource sites from disturbance by conventional oil and gas development and 142 sites as a result of impacts caused by cumulative projects foreseen including surface coal mining activities. Additional cultural resources could be found as a result of cultural resource inventories conducted before beginning surface disturbing activities. Locating additional cultural resources would result in a better understanding of the nature and distribution of those resources.

The TRR tabulated all cultural resources within a 100-foot ROW of the proposed corridor and extending 1,500 feet on either side of the alignment. The Surface Transportation Board's environmental analysis section for its SEIS indicated that with mitigation neither the construction nor the operation of the TRR would result in significant impacts to cultural resources.

Identified traditional cultural properties within the 3,000-foot-wide corridor consist of two known sites. One site (24BH1617) was identified as a medicine wheel and the other site is an important paint/mineral source currently used by the Northern Cheyenne Tribe to obtain red ochre (Deaver and Tallbull 1991) Both of these sites could be affected by visual or audible impacts caused during construction; however, mitigation measures, as agreed to with the tribes, would be implemented.

Based on the information presented in the environmental analysis section of the FSEIS, it appears that battlefields and TCPs would most likely be indirectly affected by TRR operation and maintenance.

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Alternative A has the least impact to cultural resources of all alternatives since this alternative has the least amount of surface and subsurface disturbance. Approximately 17 cultural resource sites would be identified by all projected CBNG activities in state and BLM planning areas. An estimated four sites would be impacted from exploration activities in

state planning areas; six sites would be impacted from production activities at CX Ranch; and seven would be impacted from exploration activities in BLM planning areas. One or two of these identified sites could be found eligible for the National Register of Historic Places. There would be no production activities in BLM planning areas under this alternative and therefore no impacts from production.

Crow Reservation

Impacts to cultural resources on the Crow Reservation are not expected because no exploration wells are planned for installation on the Reservation at this time. However if exploration wells were to be drilled on the Reservation the likelihood of site impacts would occur at a similar frequency as described for Cultural Resources in general though there could be an increase in cultural resource sites identified because of the increased number of possible TCPs.

Northern Cheyenne Reservation

Impacts to cultural resources on the Northern Cheyenne Reservation also are not expected at this time because the Northern Cheyenne have not indicated that exploration wells would be drilled. As with the Crow Reservation, it is anticipated that, should the Northern Cheyenne Tribe explore its reservation for CBNG resources, cultural resources would be encountered with the same regularity as described for cultural resources in general. It is conceivable that the density of cultural sites would be increased on the reservation because of the increased possibility of TCPs. It is assumed that the tribe would be involved in all surveys and site inspections on the reservation. Therefore, the incidents of cultural resource impacts could be minimized and possibly avoided altogether.

Conclusion

Over the next 20 years, disturbances from CBNG development, conventional oil and gas development and other cumulative effect analysis project activities could identify 4,285 cultural resource sites. Impacts from surface disturbance would be minimized by using existing disturbances where possible and by allowing aboveground utility lines. The impacts from erosion as a result of surface discharge of produced water at CX Ranch would be negligible because of the conveyance systems used to transport the relatively small amount of discharged water. The mitigation measures would be the same as those discussed in Chapter 2. However, given the number of acres likely to be disturbed by all anticipated CBNG development, it is unlikely that it would be necessary to mitigate sites or cultural properties through data recovery. In almost all situations, direct impacts to cultural properties would be avoided by relocating well sites or pipelines. Monitoring may indicate sites adjacent to the development fields are being indirectly affected by vandalism and other types of indirect impacts in which case data recovery would be the preferred mitigation. Consultation with tribes may indicate the presence of TCPs that would have to be avoided or which would require alteration of the well field plan in order to mitigate impacts to TCPs.

These are the best estimates of cultural resources that can be derived at this level of study. It is understood that sites occur in clusters based on a host of various criteria (location to water, slope, view, predominate wind, etc) and that some sites are more important than others.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Under this alternative, an estimated 629 cultural resource sites would be identified by all projected CBNG activities in state and BLM planning areas. An estimated 16 sites would be impacted by exploration activities in state planning areas, 335 sites from production activities in state planning areas, 10 sites from exploration activities in BLM planning areas and 269 sites from production activities on BLM planning areas.

Crow Reservation

Impacts to cultural resources on the Crow Reservation would be minimal because no development is anticipated on the reservation at this time. Disturbance totals include TCPs that would be identified off reservation and impacted from the above mentioned activities.

Northern Cheyenne Reservation

There would be no impacts to cultural resources on the Northern Cheyenne Reservation based on commercial CBNG development within the region. Disturbance totals include TCPs that would be identified off reservation and impacted from the above mentioned activities.

Conclusion

Over the next 20 years, disturbances from CBNG development in state, BLM, Native American and

USFS planning areas; conventional oil and gas development; and surface coal mining activities would identify approximately 5,135 cultural resource sites. These totals include traditional cultural properties that would be identified and impacted from the abovementioned activities. The requirement of transportation corridors, one-way in-and-out roads and the prevention of surface discharge of produced water would help to minimize the number of cultural resource sites impacted. The mitigation measures would be the same as those discussed in Chapter 2.

Alternative C—Emphasize CBNG Development

Under this alternative, impacts to cultural resources would be similar to Alternative B with the following exceptions: transportation corridors are not required, thereby increasing the number of disturbed acres and the likelihood of identifying and, hence, disturbing, more sites; discharge of produced water directly to the ground surface would increase erosion and site disturbance; power lines may be aboveground or buried, which would decrease the number of disturbed acres. The estimated number of cultural sites identified under Alternative C would total 629.

Crow Reservation

There would be no impacts to cultural resources on the Crow Reservation from commercial CBNG development in the region.

Northern Cheyenne Reservation

Impacts to cultural resources on the Northern Cheyenne Reservation would be minimal based on the off-reservation development and avoidance practices employed.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance from roads and utilities would be greater because one-way in-and-out roads and transportation corridors would not be required. Cultural resource inventories would need to be conducted along the surface watercourses. Surface discharge of produced water would result in increased erosion. The discharge of produced water to the surface would increase erosion and cause increased surface disturbance. The increased surface disturbance would be in the area near the production area and in the downstream segments of perennial streams and valleys leading to the major surface waters. Further discussion of erosion and the disturbances to soils can be found in the Soils section of this chapter. Mitigation measures would be similar to Alternative B with some exceptions. Mitigation measures would include the use of piping instead of discharging waters into drainage ditches in order to minimize erosion.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Under this alternative, impacts to cultural resources would be similar to Alternative B.

Crow Reservation

There would be no impacts to cultural resources on the Crow Reservation from commercial CBNG development within the region.

Northern Cheyenne Reservation

There would be no impacts to Northern Cheyenne cultural resources on the reservation from off-reservation CBNG development. Off-reservation TCPs may be impacted in some locals but avoidance and early identification should eliminate any important sites from being disturbed.

Conclusion

Cumulative impacts would be similar to Alternative B. Mitigation measures would be the same as for Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts while Maintaining Existing Land Uses

Under this alternative, the impact to cultural resources would be similar to Alternative B with the following exceptions: the removal of an inactive buffer zone around active coal mines and reservations would increase the potential acreage for CBNG development and hence potentially increase the number of cultural resources encountered; there might be a decrease in the number of well pads built since operators would be able to use vertical wells for deep coal seams; transportation and utility corridors are not required, thereby increasing the number of disturbed acres and hence encountered cultural resources; power lines may be aboveground or buried, which should decrease the number of disturbed acres in most areas.

The operator's project plan would help develop a survey identification strategy and increase the likelihood of cultural resource identification and implementation of mitigation measures. The estimated number of cultural resources identified under Alternative E would be 893 to 1,080. Additional cultural resources could be found as a result of cultural resource inventories conducted before beginning surface disturbing activities. Locating cultural resources would result in a better understanding of the nature and distribution of those resources.

Crow Reservation

No cultural resources would be impacted on the Crow Reservation from commercial CBNG development off-reservation lands. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with the tribes and their representatives.

Northern Cheyenne Reservation

No cultural resources would be impacted on the Northern Cheyenne Reservation from commercial CBNG development off-reservation lands. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with the tribes and their representatives. These measures include provisions for information sharing and for the prevention of impacts to Northern Cheyenne homestead sites, traditional plant gathering sites, important hunting and fishing locations, culturally significant springs, grave sites and human remains.

With these specific measures in place to mitigate impacts to Northern Cheyenne culturally important sites and with the BLM committed to providing technical assistance to the tribe in inventorying, recording and evaluating cultural sites, it is plausible that impacts will be reduced.

Conclusion

Over the next 20 years, disturbances from CBNG development, conventional oil and gas development and other RFFA could identify 5,398 to 5,585 cultural resource sites. With the implementation of specific Northern Cheyenne and general Native American mitigation measures impacts to off-reservation TCP sites will be reduced and data collection efforts enhanced.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative an estimated 893 to 1,080 cultural resource sites could be identified during field surveys conducted before surface disturbing activities occur for proposed CBNG exploration and production sites in the Planning Area. Locating cultural resource sites would result in the accumulation of additional artifacts and information. Impacts to cultural resources and sites identified before surface disturbing activities occur would be similar to those described in Alternatives B, C, D and E. Known cultural resources and sites would be protected by implementing mitigation measures such as locating CBNG activities to avoid cultural resources and sites and BMPs.

Given that some level of development is likely to occur in the crucial sage-grouse habitat areas, the total acreage of surveyed land will remain the same. However, less intense development over 93,529 acres would reduce the potential for direct impacts to cultural resources within these areas.

Crow Reservation

CBNG activities that would be located off of the Crow Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Crow Tribe would be protected because activities would be relocated to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources and sites is held confidential by the tribe and BLM which minimizes opportunities for the public to vandalize or steal cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious *and* cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives.

Northern Cheyenne Reservation

CBNG activities that would be located off of the Northern Cheyenne Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Northern Cheyenne Tribe would be protected due to mitigation measures

that would relocate development activities to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources and sites is held confidential by the tribe and BLM which minimizes opportunities for the public to vandalize or steal cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives. These measures include provisions for information sharing and for the prevention of impacts to Northern Cheyenne homestead sites, traditional plant gathering sites, important hunting and fishing locations, culturally significant springs, grave sites and human remains.

Conclusion

Under this Alternative, an estimated 893 to 1,080 cultural resource sites could be discovered during field surveys conducted before federal permits are approved and before surface disturbing activities occur for proposed TRR and CBNG exploration and production sites in the two RMP areas. Known cultural resources and sites would be protected by implementing mitigation measures and BMPs. Mitigation measures would be the same as those discussed in Chapter 2. Over the next 20 years, disturbances from CBNG development, conventional oil and gas development and other RFFA project activities could identify 5,398 to 5,585 cultural resource sites. Locating additional cultural resources would result in a better understanding of the nature and distribution of those resources.

The Surface Transportation Board's section of environmental analysis for its SEIS concluded that with mitigation neither the construction nor the operation of the TRR would result in significant impacts to cultural resources.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, impacts to cultural resources would be similar to Alternative F except that they would be reduced by approximately 65 percent based on the fewer number of APDs that are predicted to be issued. Under this alternative an estimated 312 to 378 cultural resource sites could be identified during field surveys conducted before surface disturbing activities occur for proposed CBNG exploration and production sites in the Planning Area.

Crow Reservation

CBNG activities that would be located off of the Crow Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Crow Tribe would be protected because activities would be relocated to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources and sites is held confidential by the tribe and BLM which minimizes opportunities for the public to vandalize or steal cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious *and* cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives.

Northern Cheyenne Reservation

CBNG activities that would be located off of the Northern Cheyenne Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Northern Cheyenne Tribe would be protected because activities would be relocated to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources and sites is held confidential by the tribe and BLM which minimizes opportunities for the public to vandalize or steal cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives. These measures include provisions for information sharing and for the prevention of impacts to Northern Cheyenne homestead sites, traditional plant gathering sites, important hunting and fishing locations, culturally significant springs, grave sites and human remains.

Conclusion

Under this Alternative, an estimated 312 to 378 cultural resource sites could be discovered during field surveys conducted before federal permits are approved and before surface disturbing activities occur for proposed TRR and CBNG exploration and production sites in the two RMP areas. Known cultural resources and sites would be protected

because activities would be relocated to avoid cultural resources and sites. Mitigation measures would be the same as those discussed in Chapter 2. Over the next 20 years, disturbances from CBNG development, conventional oil and gas development and other cumulative effect analysis project activities could identify 4,817 to 4,883 cultural resource sites. Locating additional cultural resources would result in a better understanding of the nature and distribution of those resources.

Transportation Boards' section of environmental analysis for their SEIS concluded that with mitigation neither the construction nor the operation of the TRR would result in significant impacts to cultural resources.

Alternative H—Preferred Alternative - Multiple Screens

Under this alternative an estimated 893 to 1,080 cultural resource sites could be discovered during field surveys conducted before surface disturbing activities occur for proposed CBNG exploration and production sites in the Planning Area. Of these sites, the majority are predicted to be located in the Powder River RMP area. Locating cultural resource sites would result in the accumulation of additional artifacts and information. Impacts to cultural resources and sites identified before surface disturbing activities occur would be similar to those described in Alternatives B, C, D and E. Known cultural resources and sites would be protected by implementing mitigation and BMPs, such as locating CBNG activities to avoid cultural resources and sites.

Crow Reservation

CBNG activities that would be located off of the Crow Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Crow Tribe would be protected because activities would be relocated to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources is held confidential by the tribe and BLM which minimizes opportunities for theft and vandalism of cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives.

Northern Cheyenne Reservation

CBNG activities that would be located off of the Northern Cheyenne Reservation would not directly impact cultural resources or sites located on the reservation. Cultural resources and sites located off of the reservation related to the Northern Cheyenne Tribe would be protected because activities would be relocated to avoid cultural resources and sites. Consultation with the tribe would update knowledge about cultural resources and sites and improve the likelihood to avoid known cultural resources and sites. Information about these resources is held confidential by the tribe and BLM which minimizes opportunities for theft and vandalism of cultural resources. With regards to off-reservation TCPs, the BLM has developed specific mitigation measures for protecting sites of religious and cultural concern to Native Americans. These measures have been developed in consultation with tribes and their representatives. These measures include provisions for information sharing and for the prevention of impacts to Northern Cheyenne homestead sites, traditional plant gathering sites, important hunting and fishing locations, culturally significant springs, grave sites and human remains.

Conclusion

Under this Alternative, an estimated 893 to 1,080 cultural resource sites could be discovered during field surveys conducted before federal permits are approved and before surface disturbing activities occur for proposed TRR and CBNG exploration and production sites in the two RMP areas. Known cultural resources and sites would be protected because activities would be relocated to avoid cultural resources and sites. Mitigation measures would be the same as those discussed in Chapter 2. Over the next 20 years, disturbances from CBNG development, conventional oil and gas development and other cumulative effect analysis project activities could identify 5,398 to 5,585 cultural resource sites. Locating additional cultural resources would result in a better understanding of the nature and distribution of those resources.

The Transportation Boards' section on environmental analysis for their SEIS concluded that, with mitigation, neither the construction nor the operation of the TRR would result in significant impacts to cultural resources.

Geology and Minerals

Geology and Minerals
Montana's mineral resources are intimately tied to the complex geologic framework of the state. Locatable minerals and conventional Oil and Gas resources are found throughout the Planning Area in various recoverable and non-recoverable amounts

Alternative A
No Action (Existing CBNG Management)

- Federal:
  - Only minor loss of CBNG during testing operations.
- State:
  - Irretrievable commitment of CBNG resources from production on state planning areas.
  - Delayed development or expansion of conventional oil and gas, coal mining and surface mineral mining in minor instances with no interruption to existing activities.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Federal:
  - Irretrievable commitment of CBNG resources from production, magnitude and complexity to reflect increase scale of development.
  - Potential mineral drainage between federal mineral estates and state, private and tribal developments depending on site-specific conditions.
- State:
  - Increased commitment of CBNG resources due to increased level of CBNG development.
  - Mineral drainage issues same as for federal.
  - The presence of shallow CBNG production could delay certain types of seismic prospecting for conventional oil and gas reservoirs

Alternative C
Emphasize CBNG Development

- Federal:
  - Same as Alternative B with minor increase in water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone.
- State:
  - Same as Alternative B.
  - Potential mineral drainage between federal mineral estates and state, private, or tribal developments depending on site-specific conditions.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Federal:
  - Same as Alternative B.
- State:
  - Same as Alternative B.
  - Potential mineral drainage between Federal mineral estates and state, private, or tribal developments depending on site-specific conditions.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Federal:
  - Same as Alternative B with the addition of increased water drawdown and potential operational interference within and adjacent to coal mines without the 1-mile buffer zone.
  - Protection of tribal CBNG from drainage because of resource protection protocols.
- State:
  - Potential mineral drainage between federal mineral estates and state, private or tribal developments depending on site-specific conditions.

Alternative F
Phased Development Multiple Screens (High Range)

- Federal:
  - Rate of development managed by limit set on the number of Federal APDs that would be approved per year
  - Geographic development of CBNG resources managed through limits set on the number of federal APDs allowed for each 4th Order Watershed
  - Limit on amount of untreated produced water from federal wells discharged within each 4th Order Watershed.
  - Amount of acres disturbed in crucial habitat areas managed by limits associated with federal wells.
  - Protection of tribal resources from federal wells within 5 miles of reservation boundaries.
  - Potential drainage of federal CBNG from production on state, private and tribal leases depending on site-specific conditions, increased potential for drainage of federal CBNG due to the cumulative limit on the number of Federal APDs allowed per year.
  - Potential drainage of federal CBNG underlying crucial sage-grouse habitat, or a reduction in the production of federal CBNG in crucial sage-grouse habitat if alternative development scenarios are implemented.
- Potential operational interference within coal mine permit boundaries and adjacent to coal mines.
- State:
  - Increased commitment of CBNG resources due to increased level of CBNG development.
  - Potential drainage of the federal CBNG from production on state and private leases depending on site-specific conditions.
  - Potential for drainage or lower levels of production from some private and state leases if operators cannot economically develop small tracts of these leases within the crucial sage-grouse habitat areas.
- The presence of CBNG production could delay certain types of seismic activities.

Alternative G
Phased Development Multiple Screens (Low Range)

- Federal:
  - Rate of development managed by limit set on the number of Federal APDs that would be approved per year.
  - Geographic development of CBNG resources managed through limits set on the number of federal APDs allowed for each 4th Order Watershed.
  - Limit on amount of untreated produced water from federal wells discharged within each 4th Order Watershed.
  - Amount of acres disturbed in crucial habitat areas managed by limits associated with federal wells
  - Protection of tribal resources from federal wells within 5 miles of reservation boundary.
  - Potential drainage of the federal CBNG from production on state, private and tribal leases depending on site-specific conditions, increased potential for drainage of federal CBNG due to the cumulative limit on the number of Federal APDs allowed per year.
  - Potential drainage of federal CBNG underlying crucial sage-grouse habitat, or a reduction in the production of federal CBNG in crucial sage-grouse habitat if alternative development scenarios are implemented.
  - The presence of CBNG production could delay certain types of seismic activities
- State:
  - Increased commitment of CBNG resources due to increased level of CBNG development.
  - Potential drainage of the federal CBNG from production on state and private leases depending on site-specific conditions.
  - Potential for drainage or lower levels of production from some private and state leases if operators cannot economically develop small tracts of these leases within the crucial sage-grouse habitat areas
- The presence of CBNG production could delay certain types of seismic prospecting for conventional oil and gas reservoirs

Alternative H
Preferred Alternative - Multiple Screens

- Federal:
  - Rate of development managed by the number of Federal APDs that would be approved per year to protect other resources.
  - Geographic development of CBNG resources managed by the location of federal APDs approved to protect other resources.
  - Amount of acres disturbed in crucial habitat areas managed by limits associated with federal wells
  - Protection of tribal resources from federal wells within 5 miles of reservation boundaries.
  - Potential drainage of the federal CBNG from production on state, private and tribal leases depending on site-specific conditions, increased potential for drainage of federal CBNG due to the cumulative limit on the number of Federal APDs allowed per year.
  - Potential drainage of federal CBNG underlying crucial sage-grouse habitat, or a reduction in the production of federal CBNG in crucial sage-grouse habitat if alternative development scenarios are implemented.
- The presence of CBNG production could delay certain types of seismic activities.
- Irretrievable commitment of CBNG resources from production, magnitude and complexity to reflect increase scale of development.
- Potential drainage of federal CBNG from production on state, private and tribal leases depending on site-specific conditions.
- Potential operational interference within coal mine permit boundaries and adjacent to coal mines.
- Protection of tribal CBNG from drainage by federal CBNG wells because of 5-mile buffer zone.
- The presence of CBNG production could delay certain types of seismic prospecting for conventional oil and gas reservoirs.
- State:
  - Increased commitment of CBNG resources due to increased level of CBNG development.
  - Potential mineral drainage of the federal mineral estates from production on state and private leases depending on site-specific conditions.

Assumptions

Federal oil and gas leases would continue to be issued with standard lease terms and stipulations as identified by BLM. No Surface Occupancy (NSO), Controlled Surface Use (CSU) and Timing Restriction (Timing) stipulations provide protection to other resources from oil and gas lease activities. A detailed listing and description of stipulations are found in the Final Oil and Gas EIS/Amendment (BLM 1992).

- Federal APDs and Sundry Notices would continue to be issued with Conditions of Approval (COAs) as identified by BLM. COAs provide mitigation to minimize or eliminate impacts to other resources or land uses from oil and gas activities. COAs must conform to lease rights and land use decisions.
- BLM would continue to consult with private surface owners before approving oil and gas activities on private surface. Surface owner requirements can be incorporated as COAs.
- BLM would continue to require a certification that a signed agreement between the private surface owner and the CBNG operator exists before approving drilling operations on private surface.
- The Miles City Field Office and the Reservoir Management Group located in the Casper BLM Office would share drainage case information for

cases within one mile of the Montana Wyoming state line.

- Other related Assumptions regarding typical CBNG operations are found at the beginning of this chapter.

Impacts From Management Common to All Alternatives

The production or drainage of oil and gas results in the irreversible and irretrievable loss of these resources. Oil and gas resources within a lease area can be directly removed by wells located on the lease area or drained by wells located adjacent to the lease when geologic conditions allow. Gas resources are irreversibly and irretrievably lost during venting or flaring operations. The cumulative impact to oil and gas resources would be a reduction in the known amount of these resources.

Existing BLM and State regulations allow for the production of oil and gas in a manner that conserves those resources so they are not wasted. Oil and gas production is guided by well spacing rules, field rules, lease development requirements and protective agreements such as communitization and unitization agreements. Flaring and venting operations must be conducted in accordance with agency approval, which also seeks to limit the wasting of gas resources as well as minimizing air quality and safety impacts.

CBNG development in Wyoming would result in drainage to Montana lands by wells just across the state boundary. The 80-mile-wide belt of the Powder River Basin that is prospective for CBNG would represent approximately 320 1/4-by-1/2-mile (80-acre) spacing units draining resources (gas) from the adjacent state. Hydrocarbon (including CBNG) drainage is mitigated by regulations contained in 43 CFR Parts 3100, 3106, 3108, 3130 and 3160. These regulations are meant to avoid waste and protect correlative mineral rights. Regulatory mechanisms include communitization agreements, protection well demands and compensatory royalties.

Oil and gas development would impact strippable coal resources in areas adjacent to existing coal mines or in new areas of coal mine interest. Oil and gas well bores and the production infrastructure would hinder the mining of coal in areas of oil and gas production.

BLM-issued oil and gas leases are issued with an NSO stipulation in an area with an active federal coal lease and an approved mine plan. The NSO stipulation prohibits surface occupancy and use for oil and gas lease operations. In areas outside of approved mine plans, BLM may issue both coal and oil and gas leases on the same parcel of land. BLM regulations support approval of applications from the first lessee, but also require lessees to resolve conflicts. Resolution of conflicts is further guided by BLM Instruction Memorandum WO-IM-2003-253 (BLM 2003a).

Conventional oil and gas lease operations would not impact CBNG resources because of the geology and well bore requirements. Migration of conventional oil and gas from source rocks to coal seams usually does not occur because of impermeable layers that exist between the hydrocarbon bearing formations and the coal seams. The BLM and State require well bores to be completed with steel casing and cement in key locations of the well annulus to prevent the migration of fluids and drastically reduce the migration of hydrocarbons from one formation to another formation.

Conventional oil and gas wells and the associated infrastructure could be located on a lease area with CBNG wells and associated infrastructure.

Sand, gravel, or scoria needed for lease operations can be removed from BLM-administered surface by the operator from areas disturbed by lease operations under authority of the lease. Removal of sand, gravel, or scoria from BLM-administered surface by the operator outside of the area of disturbance for lease operations or removal by a third party would require a separate permit approved by BLM.

Methane migration due to CBNG extraction is a possibility but highly unlikely based on the nature of the Powder River Basin methane, the low-grade coals present in the basin and the geologic formations between the coal seams and the ground surface. These low-grade, low-strength coals do not support extensive fracturing that might give rise to methane seeps (GRI 2000). Furthermore, preliminary results of the on-going BLM Casper, Wyoming study, (see Chapter 3 geology and minerals discussion) do not indicate that seepage is occurring (Personal Communication, Dan Leeman, Mike McKinley and Ed Heffern, November 2005).

The methane contained in Fort Union coals of the PRB is present in a free state, adsorbed on interior pore surfaces and micropores of the coal matrix and dissolved in water contained within the coal seam. CBNG wells depressurize coals by producing water, as water production continues coals begin producing methane as the pressure drops below the local desorption pressure threshold. With continued water production, pressure around the CBNG wells drops

and the depressurization front migrates out from the producing wells—as the front migrates outwards, net water movement is always toward the producing wells. Methane molecules and bubbles of gas will not migrate against the water flow within the coals. If a water well or monitoring well produces methane, this suggests the methane is indigenous to coals around the well and was mobilized by the migration of the depressurization front. Figure 4-4 below illustrates the phenomenon of de-pressurization and methane drainage.

Migration of methane is largely driven by water migration in the coal, operators report that migration within a well-managed CBNG field leads ultimately to drainage of between 40 and 80 acres per well, this is radial migration of 660 to 1320 feet over seven to ten or more years.

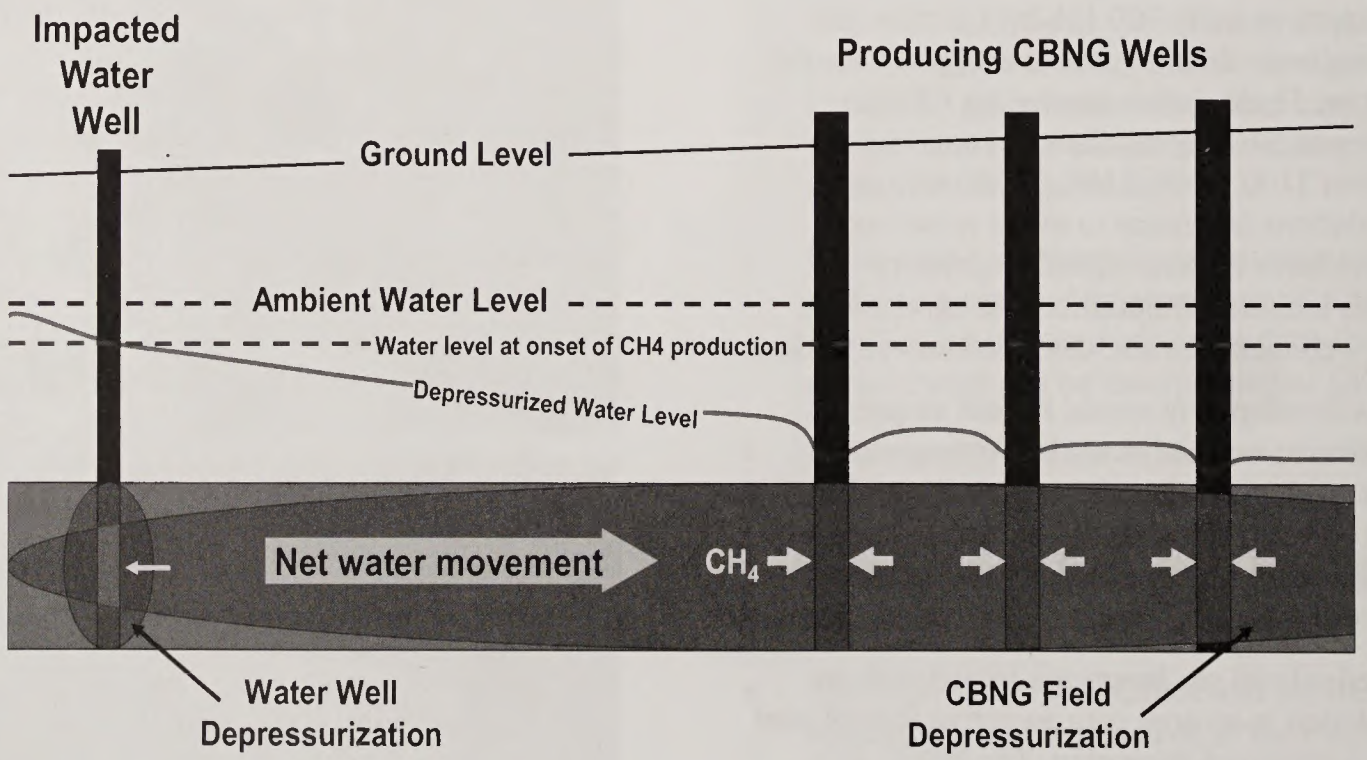
Monitoring wells in the area of Decker, Montana have been impacted by methane production since before any CBNG wells were drilled in Montana; these wells were likely impacted by dewatering performed by the coal mines in the vicinity (Wheaton et al. 2006). Some monitoring wells produced gas as soon as they were completed, even though they were located considerably outside the influences of either coal mines or CBNG production. Outside of either coal mining or CBNG activities MBMG has recorded methane release for four monitoring wells. Since the arrival of CBNG production to the Montana portion of the PRB, more water wells and monitoring wells have been recorded with methane release. The MBMG maintains a database of water wells and monitoring wells which release methane; the database currently shows four wells have been influenced by coal mine de-watering and 16 wells by CBNG dewatering. Four of the 16 wells released gas previous to CBNG development but have been noted to release more gas now (Wheaton et al. 2006).

Potential seepage areas may contain existing well bores and areas where faults, fractures, or sandstone layers occur in an orientation that provides a vertical conduit for movement of methane from depressurized coals. Methane hazard areas have not been mapped or compiled within the Project Area. No estimate of seepage is available for the PRB.

Water well mitigation agreements currently in use in the PRB were reviewed to determine the effectiveness of these agreements to alleviate the impacts of methane migration and seepage. Typical agreements included a definition of well or water source impacts that included the increased presence of methane or changes in water quality. The agreements required the operator to reconfigure, redrill, or replace; the well or water source in such a case. Access to another water source could also be

FIGURE 4-4

DEPRESSURIZATION OF CBNG STRATA AND METHANE PRODUCTION



provided as a method to mitigate such impairment. The implementation of a Water Well Mitigation Agreement can be a method to rectify the effects to domestic water wells or springs from methane migration caused by CBNG production.

BLM has the responsibility and authority to protect resources and land uses including public health and safety, from its authorized activities. BLM can impose requirements or restrictions on companies through conditions of approval included with approved permits. Implementation of conditions of approval should mitigate impacts to resources and land uses, including public health and safety.

Mitigation measures could include cisterns or gas extractors that allow the water to de-gas. Water level manipulation by way of injection wells will likely be of little use in controlling methane. The water well may ultimately need to be plugged and water supplied to the land owner by another means such as a new well completed in a different coal.

CBNG production may impact adjacent coal mines by increasing coal bed aquifer drawdown and by interfering with expansion of existing coal mines. However a symbiotic relationship could be established whereby the coal mine benefits from methane extraction prior to coal removal. The added dewatering from CBNG operations would beneficially affect the coal mines during production operations but could hinder and complicate aquifer restoration efforts once mining activities cease. In addition, the removal of coal seam water may create a situation where some coal mines would need to purchase water for dust control. Spring Creek Mine is a dry mine that does not produce water.

The drawdown of groundwater from coal seams would not damage the coal resource through compaction, nor would the likelihood of coal seam fires be greater than before. The circumstances for self-ignition of coal would not be present in the immediate vicinity of CBNG wells. During the production stage of CBNG activity, conditions essential to cultivate spontaneous combustion of coal such as oxidation, heat of wetting, airflow rate, coal particle size, pyrite content and temperature are not present. In fact, the design and construction of CBNG wells efficiently vents heat out of the coal so that temperatures needed for coal ignition are neither present nor anticipated.

All oil and gas wells, including CBNG wells, must be plugged and abandoned when the wells are no longer capable of production or needed. The plugging procedure must be approved by either BLM or the state. Unlike abandoned underground coal mines, CBNG wells leave no underground voids vulnerable to further subsidence or associated spontaneous coal ignition. The probability of completely dewatering a coal bed and exposing large areas of fine coal particles to oxygen are unlikely due to the nature of producing CBNG in the PRB (Lyman and Volkmer 2001).

The presence of CBNG wells and the associated infrastructure could prevent certain types of seismic operations from being conducted in the area of CBNG production. The use of explosives could damage well bores or surface equipment and could damage the upper coal seam used for CBNG production.

The drawdown of groundwater from CBNG activities has been identified as the cause of surface subsidence in Wyoming (Case et al. 2000). The subsidence was recorded as 1/2 inch and represents a minimal impact to surface lands. In Montana where coal seams are thinner, subsidence would be less than what has been observed in Wyoming where coal seams are thicker.

Impacts From Management Specific To Each Alternative

Alternative A—No Action (Existing CBNG Management)

Under this alternative, CBNG production would be limited by the number of wells that can be permitted for CBNG production by BLM and the State. The total number of producing CBNG wells is limited to 250 by the terms of the Settlement Agreement affecting the State. The constraint is in place until the State has completed an EIS addressing the impacts from CBNG field development throughout the state. BLM is not approving the production of CBNG from federal wells until completion of the EIS, which addresses the impacts from CBNG field development in the Powder River and Billings RMP areas.

The production and venting of CBNG during the testing phase represent an irretrievable loss of that resource. Under the existing situation, CBNG may be drained from federal lands by producing CBNG wells on private and state leases. This drainage of federal CBNG represents an irretrievable loss of that resource. The venting of CBNG during coal mining represents the irretrievable loss of the resource.

Expansion of the Decker coal mine to the west and south and expansion of the Spring Creek coal mine to the south would be constrained by CBNG wells and the associated infrastructure of the CX Field. Mine

expansion could occur after abandonment of the CX Field and removal of facilities and equipment.

Removal of groundwater by CBNG wells in coal seams that are being mined by Decker and Spring Creek could reduce the amount of groundwater flowing into the mine areas. Reduction in the amount of groundwater or degradation of groundwater quality by CBNG production would reduce the amount of groundwater available for domestic water wells from a particular coal seam. CBNG could migrate to domestic wells or escape at the surface from the removal of groundwater for CBNG production.

Crow Reservation

Producing CBNG wells located within one mile of the Crow Reservation boundary could drain CBNG resources from the Reservation. This drainage of Indian owned or privately owned CBNG would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBNG wells and associated infrastructure on private and state lands could influence the location of future CBNG wells and associated infrastructure on lands within the Crow Reservation. This scenario is not anticipated under Alternative A because of the State Settlement Agreement.

A detailed description of potential drainage impacts to Crow resources is found in the *Environmental Justice* section and a detailed description of potential impacts to groundwater from drawdown by CBNG wells is found in the Hydrology section.

Northern Cheyenne Reservation

It is not anticipated any producing CBNG wells would be located within one mile of the Northern Cheyenne Reservation boundary and therefore drainage of tribal CBNG resources from the Reservation is not anticipated.

Conclusion

The production of CBNG by state and private wells and the venting of CBNG represent the irreversible and irretrievable loss of the resource. The restrictions on the total number of CBNG wells approved for production reduces and delays associated revenues to lessees and government. The venting of CBNG during coal mining represents the irreversible and irretrievable loss of the resource.

Production of CBNG should not impact the geology of the production area or any conventional oil and gas in the area of CBNG production. CBNG wells and the associated infrastructure would hinder the expansion of the Decker and Spring Creek coal mines toward the CX Field. The production of CBNG would not prohibit the production of conventional oil and gas resources from the area of CBNG production. The production of conventional oil and gas in or around the CX Field would increase and intensify the impacts to other resources and on land uses.

The mitigation measures for this alternative would be similar to those described in Chapter 2.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Under this alternative, the types of impacts experienced would be similar to those described under Alternative A, but increased because of expanded CBNG production on state, private and BLM oil and gas lease areas. The increased development as part of this alternative would result in more CBNG production and the irretrievable commitment of more resources. Increased CBNG production would amplify the opportunity for methane drainage from adjacent leases. Under this alternative, multiple coal seams would be developed from a single well bore. All coal seams would be developed at the same time and directional drilling for deeper coal seams would be required.

This alternative also includes a 1-mile buffer zone around active coal mines that would minimize the operational interference and water drawdown impacts from nearby CBNG production. Production of CBNG would not be authorized on federal leases within a 2-mile buffer zone in Montana along the Reservation boundary. The state may allow production of CBNG from state leases within the buffer zone. The prohibition on the production of CBNG within the buffer zone would not apply to private leases within the buffer zone.

The drawdown of groundwater from coal seams would not damage the coal resource present through compaction, nor would the likelihood of coal seam fires be greater than before. The circumstances for self-ignition of coal would not be present in the direct vicinity of CBNG wells in the emphasis area. During the production stage of CBNG activity, conditions essential to cultivate spontaneous combustion of coal such as oxidation, heat of wetting, airflow rate, coal particle size, pyrite content and temperature are not present. In fact, the design and construction of CBNG wells efficiently vents heat out of the coal so that temperatures needed for coal ignition are neither present nor anticipated.

After the coal seam is exhausted of economically recoverable methane resources, wells must be plugged and sealed. Unlike abandoned mines, CBNG wells leave no underground voids vulnerable to further subsidence and associated spontaneous coal ignition. The probability of completely dewatering a coal bed and revealing large areas of fine coal particles to oxygen seem exceedingly remote (Lyman and Volkmer 2001). Further discussion regarding groundwater issues is contained in the *Hydrology* section of this chapter.

The drawdown of groundwater from CBNG activities has been identified as the cause of surface subsidence in Wyoming (Case et al. 2000). The subsidence was recorded as 1/2 inch and therefore represents a minute impact to surface lands. In Montana where coal seams are thinner, subsidence would be less than what has been observed in Wyoming where coal seams are thicker.

Crow Reservation

Impacts to mineral resources on the Crow Reservation would be the same as described above in this alternative. Producing CBNG wells located within one mile of the Crow Reservation boundary could drain CBNG resources from the Reservation. This drainage of Indian owned or privately owned CBNG would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBNG wells and associated infrastructure on private and state lands could influence the location of future CBNG wells and associated infrastructure on lands within the Crow Reservation. Expanded CBNG development activities would increase the impacts and extraction of tribal CBNG resources.

Northern Cheyenne Reservation

Impacts to mineral resources on the Northern Cheyenne reservation would be the same as described above in this alternative. Producing CBNG wells located within one mile of the Northern Cheyenne Reservation boundary could drain CBNG resources from the Reservation. This drainage of Indian owned or privately owned CBNG would represent an irretrievable loss of the resource and a loss of royalties to the mineral owner. The location of CBNG wells and associated infrastructure on private and state lands could influence the location of future CBNG wells and associated infrastructure on lands within the Crow Reservation. Expanded CBNG development activities would increase the impacts and extraction of tribal CBNG resources.

Conclusion

One of the cumulative impacts from this alternative would be increased production of CBNG from an increased number of producing wells including tribal wells and from multiple coal seam development simultaneously. Multiple coal seam development simultaneously would result in the production of a higher rate of CBNG than single seam completions. Along with venting of CBNG during well testing, this would represent an irreversible and irretrievable loss of the resource.

The increased number of producing CBNG wells and the associated infrastructure could inhibit the expansion of existing coal mines, even with the 1-mile buffer zone. This would delay or possibly preclude the mining of coal in certain areas. Areas of new coal mine interest would be excluded from opening new coal mines by the existence of producing CBNG wells and infrastructure.

The mitigation measures for this alternative would be similar to those described in Chapter 2. Additional mitigation measures include buffer zones around existing coal mines and simultaneous production of multiple coal seams through single well bores, subsurface injection of untreated water produced with CBNG and maximizing the number of producing CBNG wells connected to field compressors.

Alternative C—Emphasize CBNG Development

Under this alternative, CBNG production could occur on state, private and BLM lease areas. Operators would not be required to produce CBNG simultaneously from multiple coal seams through a single well bore. CBNG production from multiple coal seams could occur simultaneously through single well bores or simultaneously through separate well bores or different coal seams could be developed separately (staggered over time) or a combination of production methods.

Allowing CBNG production from state, private and BLM leases would increase the amount of CBNG produced. Producing CBNG from multiple coal seams simultaneously would have impacts similar to those described in Alternative B. The potential for drainage of CBNG resources by producing CBNG wells would increase with the increase in the number of producing wells. Directional drilling would not be required. Without directionally drilled wells, the impacts from vertical wells would be the same as Alternative A but increased for the scale of development.

CBNG production will impact adjacent coal mines by increasing coal bed aquifer drawdown and by interfering with expansion of existing coal mines. The added dewatering from CBNG operations would affect the coal mines by hindering and complicating aquifer restoration efforts the mine must perform once mining activities cease. In addition, the removal of coal seam water may create a situation where some coal mines would need to purchase water for dust control.

The drawdown of groundwater does not represent an immediate impact to surface lands resulting from subsidence. The thinness of the coal seam aquifers and their shallow depth should prevent them from being substantially impacted by groundwater withdrawal and subsequent aquifer compaction.

Crow Reservation

Impacts on the Crow Reservation would be the same as described for the study area in general for Alternative C. However, without the 2-mile Reservation buffer zone, tribal CBNG resources would have an increased vulnerability to drainage from adjacent state, federal and private wells.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the study area under this Alternative. Furthermore, without the 2-mile Reservation buffer zone, tribal CBNG resources would have an increased vulnerability to drainage from adjacent state, federal and private wells.

Conclusion

The cumulative impacts for this alternative would be similar to Alternative B with some exceptions. The removal of the requirement for a buffer zone around coal mines would result in increased drawdown and greater operational interference within the mines from CBNG production. After mining has ceased, the added dewatering will need to be remediated by the mine operators. Remediation bonds executed by the mine operators prior to operations will need to be honored. Unless the impact of the CBNG production can be separated from impacts by the coal mine, the remediation bond will force the mine operator to spend more money to remediate the aquifer. Coal mine operators may develop aquifer mitigation agreements with CBNG operators prior to CBNG production. The mitigation measures for this alternative would be similar to Alternative A.

Tribal development of CBNG resources on reservations would increase the irreversible and irretrievable loss of the resource.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts from management objectives outlined in Alternative D would be similar to the impacts described under Alternative B.

Crow Reservation

Impacts to the Crow Reservation would be similar to impacts described in Alternative B.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to impacts described in Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Impacts to coal and existing coal mines would be the same as Alternative C because a buffer zone would not be required around existing coal mines.

Impacts to CBNG resources would be the same as Alternative B if all coal seams are produced simultaneously or to Alternative C if coal seams are produced separately. Impacts to CBNG production and wells would be the same as Alternative A because multiple seam production through a single well bore would not be required.

Impacts on conventional oil and gas resources would be the same as discussed in the *Management Common* section.

The production of CBNG and the venting of CBNG represent the irreversible and irretrievable loss of the resource. Drainage by off-lease CBNG wells represents the irreversible and irretrievable loss of the resource and royalties to the lessee of the lease being drained.

For Alternative E, the Crow and Northern Cheyenne Reservation would be protected from drawdown of coal seam aquifers and drainage of tribal CBNG resources as described in Chapter 2 of this document. To gauge incipient impacts related to groundwater and CBNG resource drainage on the Crow and Northern Cheyenne reservations, monitoring wells

would be required to be installed during the exploration phase on all BLM-administered oil and gas leases that show hydrologic connectivity with the reservation aquifers.

Crow Reservation

Impacts to the Crow Reservation from federal lease operators under Alternative E would be minimized. A buffer zone would not be established around the borders of the Reservation. However, other mitigation options would be available for consideration by the tribes. These include reducing production rates, shutting in the well or wells, payment of compensatory royalties, establishment of communitization agreements, or spacing to protect reservation CBNG resources from drainage. Under this alternative, there would be no drainage of tribal CBNG resources by federal lease operators. The potential for drainage by private lands within the reservation boundary and along the exterior boundary would still exist.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation from federal lease operators under Alternative E would be minimized. A buffer zone would not be established around the borders of the Reservation. The BLM has the responsibility to use reasonable means to prevent drainage of tribal CBNG caused by development on federal lands. Operators would be required to provide site-specific analyses prior to field development in areas of potential drainage to tribal CBNG resources. In these analyses, operators must demonstrate whether and to what extent federal CBNG production is likely to drain Reservation CBNG. The analysis would be used by BLM to determine the timing of CBNG production, monitoring requirements and additional data needs.

If monitoring or reservoir modeling indicates drainage of CBNG resources is occurring, the BLM would enter negotiations with the operator and the tribe to protect the correlative rights of the tribe. BLM requirements could include reducing production rates, shutting in the well or wells, establishment of communitization agreements, or payment of compensatory royalty.

To protect the correlative rights of the tribe from state and private CBNG development, the BLM would represent the tribe at MBOGC hearings that set spacing units for the production of CBNG resources including state and private lands. The BLM would work with the MBOGC under its existing Memorandum of Understanding to protect tribal resources that may be affected by state or private permits, or establishment of CBNG spacing units adjacent to tribal resources. Under this alternative, there would be no drainage of tribal CBNG resources by federal lease operators. The potential for drainage by private lands within the reservation boundary and along the exterior boundary would be minimized to the extent possible.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative B with the exception that injection of produced water would not be required. Injection of produced water into a subsurface formation approved by the state would be one water management option available to operators under this alternative and such disposal would not impact other mineral resources. Other produced water management options would be making produced water available for beneficial uses and treating, as needed, produced water before being discharged onto the surface or into bodies of water or used in managed irrigation. Impacts from produced water management options are described in other resource sections, such as hydrology and soils.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative, impacts to CBNG resources would be similar to Alternative E except that they would be dispersed or spread out over time and place by numerical limits for cumulative and watershed specific APDs that BLM would approve per year. Impacts to coal and existing coal mines would be the same as Alternative C except they might be delayed or dispersed over time and place. The annual, calendar-based cumulative limit placed on federal APDs approved by BLM would be set at five percent (910 APDs) of the high-range number of state, private and federal CBNG APDs (18,225) predicted to be approved in the RMP areas (as identified in the Reasonably Foreseeable Development scenario in the Statewide Document). A limit would also be established on the number of federal APDs that would be approved each year within each 4th Order Watershed. This limit would be set at the total number of wells predicted for each watershed times the predicted rate of development in the Statewide Document. These combined limits would serve to level the impacts over a 20-year development period.

Imposition of phased development limits may impair the ability of some operators to develop their leases in a timely fashion due to the inability to obtain a sufficient number of federal APDs within a given

year or timeframe to allow for development within a particular lease or area. This could result in a less orderly development of the gas resource and could result in lost or delayed revenue for the operators and other royalty interests. This less orderly development could also result in unintended environmental impacts due to possible increases in surface disturbance necessary to produce the wells. Producing infrastructure for the wells may have to bypass certain areas and then additional infrastructure installed later as wells are drilled.

The production of CBNG and the venting of CBNG represent the irreversible and irretrievable loss of the resource. Drainage of federal CBNG by off-lease CBNG wells represents the irreversible and irretrievable loss of the federal resource and royalties to the lessee as well as the federal government and state of Montana. Under Alternative F, watershed specific and cumulative numerical limits would be placed on the number of federal APDs approved each year. This could result in the situation where state and private leases that adjoin federal leases could experience CBNG resource development for a number of years prior to federal APDs being approved for the federal leases. For example, state and private APDs could use the majority of annually approved APDs (ratio 80 percent: 20 percent) for the first several years resulting in a disproportionate development pattern in the field. This would result in a delay of CBNG resources developed on federal leases. The development occurring on adjoining state or private leases would increase the potential for drainage of federal minerals and may cause wells on federal minerals to be uneconomic and not drilled. The lack of equitable and concurrent federal development would result in a loss of royalty income to the federal government as well as the state portion and a loss of income to the lessee of the federal lease.

There are currently 120 wells drilled on federal minerals within the CX Field. As a result of an Order issued by the U.S. District Court for Montana, restrictions were imposed upon BLM regarding the annual number of CBNG APDs that can be approved by BLM during preparation of the FSEIS. Subsequent to the District Court Order, the Ninth Circuit Court of Appeals issued an injunction which prohibited BLM from approving any permits for the production of CBNG in the Montana portion of the PRB. These restrictions resulted in extended delays to approximately five percent of the federal APDs submitted. Drilling and development of adjoining state and private minerals has continued and it is likely that the five percent federal mineral locations are being drained and may no longer be economical to drill. For Alternative F, if five percent of the proposed wells were not drilled because of restrictions on the number of annual APDs approved, a total of 425 wells would not be drilled representing a loss of approximately 127.5 billion cubic feet (BCF) of natural gas to the Federal Government. This would be a loss of income to the lessees of the federal leases and a loss of royalty to the federal government and to county governments.

For years 1 thru 9 of phased development under Alternative F, the number of state and private APDs issued would be greater than the number of federal/BLM APDs issued. In years 3, 4 and 5 it is predicted that no federal/BLM APDs would be issued. It is this situation that creates the increased potential to drain federal minerals from production on adjoining state and private minerals.

For Alternative F, the Crow and Northern Cheyenne reservations would be protected from drawdown of coal seam aquifers and drainage of tribal CBNG resources from federal CBNG wells by the establishment of a 5-mile buffer zone around the borders of the Crow and Northern Cheyenne reservations, except along the common border of the two reservations. Resource protection protocols that demonstrate protection of Indian groundwater and CBNG would be required to be included in each operator's POD that includes the development of federal CBNG wells within the 5-mile buffer zone. If the development of federal minerals within the 5-mile buffer zone is delayed or restricted while development on state and private leases continue, then the situation develops where there would be the increased potential for drainage of federal minerals. CBNG Indian resources could be impacted by development of state and private leases within the 5-mile buffer zone.

Within the 5-mile buffer zone of a reservation boundary, BLM managed minerals represent 24 percent (127,165 acres) of total mineral ownership (463,118 acres) within the Billings RMP Area and 64 percent (250,565 acres) of total mineral ownership (355,307 acres) within the Powder River RMP Area. These federal minerals could contain as much as 1.4 TCF of gas that may be lost to the federal and county governments [(127,165 acres + 250,565 acres)/1 well per 80 acres * 0.3BCF per well]. These statistics do not take into account the federal minerals administered by the Custer National Forrest, Ashland Ranger District.

The buffer could also cause a reduction in the development of federal leases due to the increased economic investment required to develop CBNG within the zone. Additional costs include installation of added monitoring wells and air monitoring stations

and additional geologic engineering work to demonstrate that the CBNG production would have no impact on Indian Trust Assets (ITAs). Furthermore, if companies were required to temporarily or permanently cease production of CBNG wells because of a perceived or established impact to ITAs, the decision could affect production of CBNG from any federal lease within the five mile buffer. It is unlikely that companies would be willing to invest capital in drilling and developing a lease if they are not guaranteed an opportunity to recover the capital investment and make a reasonable profit for their shareholders. This could also result in a scenario where the federal tracts in the buffer area may be leased but would be viewed as having a lesser value than a private or state lease that did not contain these same restrictions/requirements. If the lessees of the federal leases in the buffer area were not allowed to pursue development of the lease, a case might be made for a "taking" of their rights as lessee.

Under this alternative, restrictions applied to the development of federal CBNG in crucial sage-grouse habitat areas would likely lead to some level of drainage of federal CBNG from adjacent state and private wells and may actually cause some drainage impacts to private and State mineral estate. This is because the allowable development within the crucial sage-grouse habitat areas is likely to be less efficient in the recovery of the CBNG resource. If no development were to occur on Federal mineral estate within these areas, some small isolated tracts of private or State minerals would be considered uneconomic to develop and would be subject to drainage, or not developed.

A "no development" outcome would lead to a loss of Federal royalties. For an estimate of Federal royalties lost due to "no development" see the socioeconomic section. Similarly, private and State mineral estates would lose royalties. The no development outcome is considered unlikely and is used for comparing impacts between full development and no development within the crucial sage-grouse habitat areas.

Crow Reservation

CBNG resources of the Crow Tribe would be protected from production of federal CBNG through the establishment of a 5-mile buffer zone on the east, west and north sides of the reservation. The BLM has the responsibility to use reasonable means to prevent drainage of tribal groundwater and CBNG resources. Within the 5-mile buffer zone surrounding the Crow Reservation, BLM would require the operator to demonstrate the protection of Indian resources in the POD. The operator's analyses would need to demonstrate if Indian minerals and groundwater would be impacted by development of federal CBNG wells. If groundwater and minerals might be impacted, the POD must include resource protection protocols for these assets. If the POD does not show protection of Indian Trust Assets and adequate resource protection protocols are not included, BLM would not approve the APD.

Resource protection protocols could include a requirement for monitoring wells to be installed between the development area and the reservation. If monitoring indicates that Indian minerals are not being protected, then CBNG development wells would be shut-in. If CBNG development occurs on a reservation, this requirement may be modified in consultation with the tribe and other affected parties.

Other resource protection protocols that could be considered to protect reservation groundwater and CBNG resources from drainage include reducing federal CBNG well production rates, establishment of communitization agreements in consultation with the tribe, or adjusting CBNG well spacing requirements. Under this alternative, there would be no drainage of tribal CBNG resources by federal CBNG wells. The potential for drainage of undeveloped federal and Indian leases by development of state and private leases along the exterior boundary would still exist.

Northern Cheyenne Reservation

A buffer zone would be established on the south, north and east sides of the Reservation. The protection of Indian minerals and groundwater for the Northern Cheyenne Tribe would be the same as described for the Crow Tribe with the exception of drainage of Indian CBNG from the drilling of private leases within the reservation because the tribe owns the majority of minerals within the reservation.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative E with the exception that impacts would be dispersed or spread out over time and place due to the implementation of cumulative and watershed specific numerical limits on the number of federal CBNG APDs approved per year. Delays in the development of CBNG resources on federal leases could result in the increased potential for drainage of federal minerals due to the development of CBNG resources on adjoining state or private leases. This alternative could lessen the value of federal leases because of drainage occurring from offsetting private and state wells that would

never be recovered. Conflicts could arise between lessees over who can develop first, or at all and the resultant loss of revenue to the lessee. This alternative could also require the federal government to extend leases beyond their primary term without production due to the government not allowing timely development.

Indian CBNG and groundwater would be protected from production of federal CBNG wells through the implementation of a 5-mile buffer zone within which operators would be required to conduct site-specific analyses and develop resource protection protocols that would be included with their PODs for any CBNG wells to be drilled on federal leases. The buffer zone and protection protocols would not apply to wells approved by the state which could result in direct and indirect impacts to groundwater and CBNG located under the reservations.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, impacts to CBNG resources would be similar to Alternative F except that they would be reduced by approximately 65 percent based on the fewer number of APDs that are predicted to be issued. Under Alternative G, the annual cumulative limit placed on federal APDs approved by BLM would be set at five percent (323 APDs) of the low-range number of state, private and federal CBNG APDs (6,470) predicted to be approved in the RMP areas (as identified in the Reasonably Foreseeable Development scenario in the Statewide Document). A limit would also be established on the number of federal APDs that would be approved each year within each 4th Order Watershed. This limit would be set at the total number of wells predicted for each watershed times the predicted rate of development in the Statewide Document These combined limits would serve to level the impacts over a 20-year development period.

Since the annual rate of development would be limited to five percent of the cumulative APDs predicted, the potential for the drainage of federal minerals from production on adjacent or adjoining state or private leases would be the same as for Alternative F. In years 1 through 9, the number of state and private APDs issued would be greater than the number of federal/BLM APDs issued and in years three, four and five when it is predicted that no federal/BLM APDs would be issued. This would create the potential for an increase in the drainage of federal CBNG by production on adjacent state and private leases. Applying the same example as outlined under Alternative F, if five percent of federal CBNG wells are not drilled this would represent approximately 150 wells and a loss of approximately 45 BCF of natural gas from federal leases. This would be a loss of income to the lessees of the federal leases and a loss of royalty to the federal government and the counties and state of Montana.

Imposition of phased development limits may impair the ability of some operators to develop their leases in a timely fashion due to the inability to obtain a sufficient number of APDs within a given year or timeframe to allow for development within a particular lease or area. This could result in a less orderly development of the gas resource and could result in lost or delayed revenue for the operators and other royalty interests. This less orderly development could also result in unintended environmental impacts due to possible increases in surface disturbance necessary to produce the wells. Producing infrastructure for the wells may have to bypass certain areas and then additional infrastructure installed later as wells are drilled.

For Alternative G, a 5-mile buffer zone would be established around the borders of the Crow and Northern Cheyenne reservations. Resource protection protocols and potential impacts, including the increased potential for the drainage of federal minerals due to delayed or restricted development of federal leases, would be the same as for Alternative F.

Crow Reservation

Impacts to the Crow Reservation would be similar to impacts described in Alternative F.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to impacts described in Alternative F.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative F except that they are expected to be less due to approximately 65 percent fewer APDs being issued. Impacts would be dispersed or spread out over time and place due to the implementation of cumulative and watershed specific numerical limits on the number of federal CBNG APDs approved per year. Delays in the development of CBNG resources on federal leases could result in the increased potential for drainage of federal minerals due to the development of CBNG resources on adjoining state or private leases. This alternative could lessen the value of federal leases because of drainage occurring from offsetting private and state wells that would never be recovered. Conflicts could

arise between lessees over who can develop first, or at all and the resultant loss of revenue to the lessee. If lessees are not allowed to develop the gas resources this would result in a loss of the resource to the nation. This alternative could also require the federal government to extend leases beyond their primary term without production due to the government not allowing timely development.

ITAs would be protected through the implementation of a 5-mile buffer zone within which operators would be required to conduct site specific analyses and develop mitigation measures and monitoring that would be included with their POD for any CBNG wells to be drilled on federal leases. The buffer zone and mitigation measures would not apply to wells approved by the state which could result in direct and indirect impacts to groundwater and CBNG located under the reservations.

Alternative H—Preferred Alternative - Multiple Screens

Under this Alternative, impacts to federal leases, CBNG resources and federal lessees would be similar to Alternative F. This Alternative manages the pace (rate) and place (geography) of federal CBNG development through protection measures applied to crucial habitat areas and limits to the discharge of untreated produced water from federal CBNG wells and emissions from sources associated with federal CBNG wells. More federal APDs could be approved annually and geographically than under Alternatives F and G as long as other resources are protected. Monitoring data would be required to help BLM determine which (where and when) federal APDs could be approved. These limits and thresholds (see Wildlife Appendix and Hydrology section) would serve to level the cumulative impacts over time. The production of CBNG would continue for a longer overall period of time compared to Alternative E because fewer number of federal CBNG wells may be drilled each year.

The production and venting of CBNG represents the irreversible and irretrievable loss of the resource; although the production of CBNG makes it available in the market place. Drainage of federal CBNG by off-lease CBNG wells represents the irreversible and irretrievable loss of the federal resource and loss of revenue to the operator, lessee, federal government and state of Montana.

Imposition of phased development limits may impair the ability of some operators to develop their leases in a timely fashion due to the inability to obtain a sufficient number of approved APDs within a given year or timeframe to allow for development within a particular lease or area. This could result in a less orderly development of the gas resource and could result in lost or delayed revenue for the operators, lessees, the federal government and state of Montana. This less orderly development could also result in unintended environmental impacts due to possible increases in surface disturbance necessary to produce the wells. Producing infrastructure for the wells may have to bypass certain areas and then additional infrastructure installed later as wells are drilled.

Under this alternative, restrictions applied to the development of federal leases in crucial sage-grouse habitat areas would likely lead to some level of drainage of federal CBNG from adjacent state and private wells and may actually cause some drainage impacts to private and State mineral estate. This is because the allowable development within the crucial sage-grouse habitat areas is likely to be less efficient in the recovery of the CBNG resource. If no development were to occur on federal leases within these areas, some small isolated tracts of private or State minerals would be considered uneconomic to develop and would be subject to drainage, or not developed.

A "no development" outcome would lead to a loss of Federal royalties. For an estimate of Federal royalties lost due to "no development" see the socioeconomic section. Similarly, private and State mineral owners would lose royalties. The no development scenario compares impacts between full development and no development within the crucial sage-grouse habitat areas.

Under Alternative H, the Crow and Northern Cheyenne reservations would be protected from drawdown of groundwater in coal seams and drainage of tribal CBNG from federal CBNG wells by the establishment of a 5-mile buffer zone around the borders of the reservations and implementation of mitigation measures associated with federal CBNG wells within the 5-mile zone. Mitigation measures that demonstrate protection of Indian minerals and groundwater would be required to be included in each operator's POD that includes the development of federal CBNG wells within the 5-mile buffer zone. If the development of federal minerals within the 5-mile buffer zone is delayed or restricted while development on state and private leases continue, then the situation develops where there would be the increased potential for drainage of federal minerals. Within the 5-mile buffer zone of a reservation boundary, BLM managed minerals represent 24 percent (127,165 acres) of total mineral ownership (463,118 acres) within the Billings RMP Area and 64

percent (250,565 acres) of total mineral ownership (355,307 acres) within the Powder River RMP Area. These federal minerals could contain as much as 1.4 to 1.6 TCF of gas[(127,165 acres + 250,565 acres)/1 well site per 80 acres * 0.3 to 0.34 BCF per well site]. If federal leases within the 5-mile zone are not fully developed, the gas resource may be produced by adjacent state and private CBNG wells or not fully recovered. This would also result in lower revenues to the lessee and federal, state and county governments. For an estimate of Federal royalties lost due to "no development" see the socioeconomic section.

The buffer could also cause a reduction in the development of federal leases due to the increased economic investment required to develop CBNG within the zone. Additional costs include installation of added monitoring wells and air monitoring stations and additional geologic engineering work to demonstrate that the CBNG production would have no impact on ITAs. Furthermore, if companies were required to cease production of CBNG wells because of a perceived or established impact to ITAs, the decision could affect production of CBNG from any federal lease within the 5 mile buffer. It is unlikely that companies would be willing to invest capital in drilling and developing a lease if they are not guaranteed an opportunity to recover the capital investment and make a reasonable profit for their shareholders. This could also result in a scenario where tracts in the buffer area may be leased but would be viewed at a lesser value than a private or state lease that did not contain these same restrictions/requirements. If the lessees of the federal leases in the buffer area were not allowed to pursue development of the lease, a case might be made for a "taking" of their rights as lessee.

Impacts on conventional oil and gas resources would be the same as discussed in the *Management Common* section.

Crow Reservation

CBNG resources of the Crow Tribe would be protected through the establishment of a 5-mile buffer zone around the east, west and north sides of the reservation. The BLM has the responsibility to use reasonable means to prevent drainage of tribal CBNG and groundwater resources. Within the 5-mile buffer zone surrounding the Crow Reservation, BLM would require site-specific analyses be included with the operator's POD. The operator's analyses would need to demonstrate if Indian minerals and groundwater would be impacted by development of federal CBNG wells. If groundwater and minerals might be impacted, the POD must include resource protection protocols for these assets. If the analyses do not show protection of ITAs and adequate resource protection protocols are not identified during consultation with the tribe, BLM would not approve the APD.

Resource protection protocols could include a requirement for monitoring wells to be installed between the development area and the reservation. If monitoring indicates that Indian minerals or groundwater are not being protected, then consultation with the tribe would be conducted to determine a suitable mitigation measure, or CBNG development wells could be shut-in. If CBNG development occurs on the reservation, this requirement may be modified in consultation with the tribe and other affected parties.

Other resource protection protocols that could be considered to protect reservation groundwater and CBNG resources from drainage include reducing federal CBNG well production rates, establishment of communitization agreements in consultation with the tribe, or adjusting CBNG well spacing requirements. Under this alternative, there would be no drainage of tribal CBNG resources by federal lease operators. The potential for drainage of undeveloped federal minerals by development of private leases within the reservation buffer zone and development of state and private leases along the exterior boundary would still exist.

Northern Cheyenne Reservation

A buffer zone would be established on the south, north and east sides of the Reservation. The protection of Indian minerals and groundwater for the Northern Cheyenne Tribe would be the same as described for the Crow Tribe with the exception of drainage of Indian CBNG from the drilling of private leases within the reservation because the tribe owns the majority of minerals within the reservation.

Conclusion

The cumulative impacts under this alternative would include production of CBNG from more federal wells drilled annually than under Alternatives F and G, but probably fewer federal wells drilled annually than under Alternative E. This would result in an overall longer period of time to produce CBNG in the Planning Area compared to Alternative E and probably a shorter overall period of time compared to Alternatives F and G. CBNG production represents the recovery of the resource for the nation and

revenue for federal, state and local governments, companies and individuals.

Delays in the development of CBNG resources on federal leases could result in the increased potential for drainage of federal CBNG due to the development of CBNG resources on adjoining state or private leases. This alternative could lessen the value of federal leases because of drainage occurring from offsetting private and state wells that would never be recovered. Conflicts could arise between lessees over who can develop first or at all and the resultant loss of revenue to the lessee. This alternative could also require the federal government to extend leases beyond their primary term without production due to the government not allowing timely development

The increased number of producing CBNG wells and the associated infrastructure located near coal mine permit boundaries could inhibit the expansion of existing coal mines. This could delay or possibly preclude the mining of coal in certain areas. Areas of new coal mine interest would be excluded from opening new coal mines by the existence of producing CBNG wells and infrastructure. Furthermore, CBNG related impacts particularly from federal wells would be dispersed or spread out over time and place due to the implementation of BLM imposed restrictions or "screens" previously described.

Indian groundwater and minerals would be protected through the implementation of a 5-mile buffer zone within which operators would be required to conduct site-specific analyses and develop resource protection protocols that would be included with their PODs for any CBNG wells to be drilled on federal leases. If the operators cannot demonstrate that there would be no impact to the Indian groundwater and minerals, their APDs would not be approved. This would result in a loss of the gas resource to the nation. The buffer zone and protection protocols would not apply to wells approved by the state which could result in direct and indirect impacts to groundwater and CBNG located under the reservations.

Hydrological Resources

Hydrological Resources

Surface water: Some surface waters in the Powder River Basin are of good quality and frequently used for irrigation. Other rivers are characterized as having fair to poor quality water and may go dry, the waters are used for stock and limited irrigation.

Groundwater: Groundwater is available in stream bottom alluvium, but becomes scarce away from water courses. Coal beds and interlayered sands are the most commonly used aquifers away from riparian areas. Groundwater quality is variable.

Alternative A
No Action (Existing CBNG Management)

- Federal:
  - No impacts to surface or groundwater resources
- State:
  - Negligible changes in Tongue River quality and flow.
  - Groundwater drawdown within the immediate vicinity of the CX Ranch
  - Continued beneficial reuse of produced water at the CX Ranch
- Cumulative Impacts:
  - Surface Water:
    Wyoming CBNG discharges will result in moderate increases in flow and changes in water quality in rivers shared between Montana and Wyoming, however downstream uses will not be diminished
  - Tongue River Railroad construction could lead to localized soil erosion and impact to surface water focused run-off, localized increased stream flow and increased suspended sediment.
  - Groundwater:
    Drawdown from Wyoming CBNG and the CX Ranch may extend several miles from development.
  - Beneficial Reuse:
    Wyoming and CX Ranch discharges may increase opportunities for beneficial use.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Surface Water
  - Similar to Alternative A, potential for increased sediment loads due to soil disturbance and erosion.
- Groundwater:
  - Drawn down will occur over large continuous areas
  - Immediate drawdown will be minor. However, as CBNG production matures, coal seam aquifer drawdown may extend 4 to 5 miles from the edge of production
  - No change in groundwater quality
- Beneficial Reuse:
  - Same as Alternative A
- Cumulative Impacts:
  - Surface water flow and quality will be the same as Alternative A
  - Montana and Wyoming CBNG production will noticeably drawdown coal seam aquifers
  - Groundwater quality in Montana and beneficial reuse will be the same as Alternative A

Alternative C
Emphasize CBNG Development

- Surface Water
  - Water quality in some watersheds will be noticeably altered.
  - Flows will be considerably increased.
- Groundwater:
  - Drawdown similar to Alternative B.
  - Alluvial groundwater quality may be altered due to infiltration of untreated production water
- Beneficial Reuse:
  - Same as Alternative A
- Cumulative Impacts:
  - Surface water quality in some watersheds will be noticeably altered.
  - Flows will be considerably increased.
  - Impacts to groundwater drawdown, quality and beneficial reuse will be the same as in Alternative B

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Surface Water
  - Similar to Alternative A, potential for increased sediment loads due to soil disturbance and erosion.
  - Flows will increase similar to Alternative C
- Groundwater:
  - Drawdown same as Alternative B
  - No groundwater quality impacts
- Beneficial Reuse:
  - Increased beneficial uses, estimated at 20 percent of production
- Cumulative Impacts:
  - Surface water quality will be slightly altered due to Wyoming CBNG discharges.
  - Surface water flows will be similar to Alternative C
  - Groundwater drawdown and quality changes will be the same as in Alternative B

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Surface Water
  - Water quality will be slightly altered, however beneficial uses will not be diminished
  - Flows will be moderately increased
- Groundwater:
  - Drawdown same as Alternative B.
  - Alluvial groundwater quality may be altered due to infiltration of untreated production water
- Beneficial Reuse:
  - Required Water Management Plans from all operators will result in beneficial reuse of approximately 20 percent of production
- Cumulative Impacts:
  - Cumulative impacts to surface waters will be reduced dependent on MDEQ numerical standards
  - Surface water quality will be slightly altered however downstream uses will not be diminished
  - Surface water flows will be moderately increased
  - Groundwater drawdown will be similar to Alternative B
  - Shallow groundwater quality may be slightly altered

Alternative F
Phased Development Multiple Screens (High Range)

- Surface Water:
  - Water quality will be slightly altered, however beneficial uses will not be diminished
  - Flows will be moderately increased
- Groundwater:
  - Drawdown same as Alternative B
- Beneficial Reuse:
  - Required Water Management Plans from all operators will result in beneficial reuse of approximately 20 percent of production water
- Cumulative Impacts:
  - Cumulative impacts to surface waters will be less than MDEQ standards.
  - Surface Water quality will be slightly altered,; however downstream uses will not be diminished
  - Surface water flows will be moderately increased
  - Groundwater drawdown would be similar to Alternative B
  - Conditions placed on CBNG federal mineral development within crucial sage-grouse habitat may reduce the overall number of CBNG wells developed. If no development occurs within the crucial sage-grouse habitat, the number of wells and associated produced water, would be reduced by 12.8%.

Alternative G
Phased Development Multiple Screens (Low Range)

- Surface Water:
  - Water quality will be slightly altered, however beneficial uses will not be diminished
  - Flows would slightly increase
- Groundwater:
  - Drawdown effects near CBNG fields would be the same as Alternative B, but fewer CBNG fields would be developed
- Beneficial Reuse:
  - Required Water Management Plans from all operators will result in beneficial reuse of approximately 20 percent of production water
- Cumulative Impacts:
  - Cumulative impacts to surface waters will be less than MDEQ standards.
  - Surface Water quality will be slightly altered,; however downstream uses will not be diminished
  - Surface water flows will be slightly increased
  - Drawdown effects near CBNG fields would be the same as Alternative B, but fewer CBNG fields would be developed

Alternative H
Preferred Alternative - Multiple Screens

- Surface Water:
  - Water quality will be slightly altered, however beneficial uses will not be diminished
  - Flows will be moderately increased
- Groundwater:
  - Drawdown same as Alternative B
- Beneficial Reuse:
  - Required Water Management Plans from all operators will result in beneficial reuse of approximately 20 percent of production water
- Cumulative Impacts:
  - Cumulative impacts to surface waters will be less than MDEQ standards.
  - Surface Water quality will be slightly altered,; however downstream uses will not be diminished
  - Surface water flows will be moderately increased
  - Conditions placed on CBNG federal mineral development within crucial sage-grouse habitat may reduce the overall number of CBNG wells developed. If no development occurs within the crucial sage-grouse habitat, the number of wells and associated produced water, would be reduced by 12.8%.

The key water quality parameters for predicting the potential effects of CBNG development on irrigated agriculture are sodicity (as sodium adsorption ratio, SAR) and salinity (as electrical conductivity, EC). The MDEQ believes irrigated agriculture is the most sensitive beneficial use for surface waters in the study area, thus protection of irrigated agriculture will be sufficient to protect all other beneficial uses. Instream numerical targets for these parameters are used to model environmental impacts.

The water quality standards for EC and SAR were adopted in 2003 by the Montana Board of Environmental Review (BER) to protect the most salinity-sensitive beneficial use of the streams and rivers in Montana's Powder River Basin, i.e., irrigated agriculture. The standards establish the maximum levels of EC and SAR that may be discharged into the rivers and streams throughout the basin without harming plants and soils. These standards have been approved by the U.S. EPA. As such, all Clean Water Act (CWA) permits issued in Montana must contain provisions that limit EC and SAR, so that the water quality standards will be met. In addition, all CWA permits issued in Wyoming authorizing discharges into streams that flow north into Montana contain conditions to ensure that Montana's water quality standards are not exceeded at the border. Note Montana's EC and SAR standards are currently being challenged in both Montana and federal courts.

The MDEQ water quality standards for EC and SAR are listed in Table 3-6.

In March 2006, the Montana BER amended its regulations implementing Montana's nondegradation policy in terms of EC and SAR. The State's nondegradation policy is part of the State's water quality standards program; therefore, any changes to regulations implementing the policy must be approved by EPA. Although the amended nondegradation regulations became effective under state law on May 19, 2006, they will not be enforced until approved by EPA.

Once approved, the new nondegradation requirements will apply to any proposal that would result in a new or increased discharge of EC and SAR into "high quality" waters of the State. State waters are considered high quality if the quality of those waters is better than that required by the water quality standards. Since MDEQ determines whether a water body is high quality on a parameter-by-parameter basis, a water body will be considered high quality in terms of EC and SAR, if the ambient quality of the stream is better than the water quality standards established for those parameters. A waterbody will not be considered high quality if the water is listed on the State's § 303(d) list as impaired because it does not meet the water quality standards for EC and SAR

Under Montana's nondegradation law, any change in the existing quality of high quality waters is prohibited unless an authorization to degrade is obtained from MDEQ, or the change is deemed "nonsignificant" under rules adopted by the Montana BER. Under the newly amended regulation, any change in the existing quality of a high quality stream is deemed "significant" when the ambient quality of the stream is 40 percent of the standard or above. Since all of the high quality streams within the Powder River Basin have ambient water quality that exceeds 40 percent of the standard for EC, any new proposal to discharge into those waters may require an authorization to degrade from MDEQ.

In May 2002, the Northern Cheyenne Tribe adopted numerical water quality standards for SAR and EC applicable to waters within the Reservation. Although these tribal standards do not have Clean Water Act regulatory status until approved by the EPA, the adopted numerical standards do set out the tribe's considered determination of the water quality needed to protect irrigated agriculture on the Reservation (Northern Cheyenne Tribe 2002). Standards for surface water quality proposed by the Northern Cheyenne Tribe are summarized in Table 3-24.

The Montana BER standards adopted by the MDEQ on April 25, 2003 have been used in the analysis. It should also be noted that a non-degradation criterion exists for flow on high quality waters. This flow criterion requires individual discharge permits do not cause a 10 percent increase or decrease in the 7Q10 flow or a 15 percent increase or decrease in mean monthly flow (Administrative Rules of Montana [ARM] 17.30.715.1.a). The non-degradation rules also state MDEQ may determine the change resulting from an activity is "significant" based on cumulative impacts despite it meeting the "nonsignificant" criteria for individual permits (ARM 17.30.715.2.a). It has been suggested a 40 percent increase in minimum mean monthly flow may be an appropriate level at which this cumulative significance threshold is met for flow; however this evaluation will be made based on the specific conditions which exist when each Montana Pollutant Discharge Elimination System (MPDES) permit is requested. Forty percent of minimum mean monthly flow will be used as a comparison analysis threshold for alternatives A-E and as a limiting factor for Montana discharges under alternatives F-H.

More recently, the Montana BER modified these standards by designating EC and SAR as "harmful" parameters. Harmful parameters are regulated under the non-degradation rules, which do not allow a discharge to increase a harmful parameter if ambient water quality is greater than 40 percent of the standard (see Hydrology Appendix for further details). If implemented, the effect of this rule would be that CBNG discharges to surface waters will need to be treated to ambient water quality standards since ambient EC and SAR values are greater than 40 percent of the standards in these watersheds. This modification of the EC and SAR standards has not been approved by EPA, so it does not have CWA standing and is not enforceable upstream into Wyoming. The Wyoming Governor's office has openly opposed this change. As such, it is assumed that CBNG development in Montana would have to be in compliance with these rules and treat all discharges to ambient water quality, but Wyoming development will not. If EPA approves these changes, the non-degradation rules would apply to Wyoming as well and impacts would be less than calculated. Forty percent of the EC and SAR values have been added as criteria for Alternatives A-E and are incorporated into the analysis of Alternatives F-H.

The Ayers and Westcot EC/SAR relationship is used to determine the effect of irrigation waters on the infiltration capacity of soils. This relationship recognizes that as salinity increases the potential impacts of SAR decrease. This relationship is not unbounded, however, because of the potential impact of rainfall on sodic soils. Rainfall can cause SAR problems in surface soil because of the differential

way in which EC and SAR respond to a rain event (significant lowering of the EC and little change in the SAR). This rain-on-sodic-soil problem is addressed in a number of the standards proposals (see Hydrology Appendix) through adoption of an absolute maximum SAR (i.e., the standard "caps" the Ayers and Westcot EC/SAR relationship). It will be important to be mindful of an upper bound on the Ayers and Westcot relationship in reviewing the conclusions reached in the alternatives analyses in this document. This may help explain situations where the most restrictive proposed limit (MRPL) (or perhaps, the least [LRPL]) shows a potential effect, where the Ayers and Westcot diagram indicates no reduction in infiltration. This relationship is used as criteria against which the results of the surface water quality are compared.

Another factor to consider in applying these SAR and EC values is the significant distinction between the modeling approach applied to the analysis of alternatives and the approach that eventually will be used in calculating discharge limits for future, specific CBNG projects:

- The modeling approach used in this document begins with an assumed water management method for all the reasonably foreseeable CBNG development in Montana and Wyoming and, applying a series of assumptions (see discussion below), predicts a resultant instream cumulative water quality. Predicted water quality modeling output is then displayed against the full range of proposed SAR and EC limits and other criteria.

- The water quality-based approach that is actually used to calculate future Montana Pollutant Discharge Elimination System (MPDES) permitting requirements will begin with appropriate and specific instream water quality standards. Through the total maximum daily load (TMDL) process, those standards will be translated into discharge limits for specific CBNG projects.

The standards serve as the regulatory basis for controlling CBNG discharges and the water quality-based permitting approach that implements these standards is different from the predictive modeling approach used in this EIS.

The water quality-based approach begins with a desired instream water quality and, using that as the target, calculates the CBNG discharge limits needed to ensure the desired instream water quality is achieved. The TMDL process identifies capacity for a waterbody to assimilate substances (maximum load). That capacity then has to be allocated among the appropriate governmental entities along that waterbody. It should be noted that, where a tribe is one of the appropriate governmental entities, EPA has a trust responsibility to ensure a fair and meaningful portion of the available assimilative capacity is reserved for that tribe.

The spreadsheet model used in the analysis of impacts for the EIS employs a steady state mass balance approach to estimate concentrations of EC and SAR after stream water and CBNG discharged water are mixed. The steady state mass balance approach is commonly used by the EPA in predicting possible effects of point source discharges on receiving waters. Input parameters to the spreadsheet model were developed from analysis of reasonably conservative assumptions, as well as measures of central tendency (typical or mean values).

The Surface Water Quality Analysis Technical Report (SWQATR) lists the input parameters and indicates whether conservative or mid-range values were used in the impact analysis model. The resultant spreadsheet model is considered to provide a conservative, yet reasonable estimate of the impacts of CBNG development on surface water quality in the Powder River Basin. The SWQATR also discusses the problems of manipulating sample SAR values (BLM 2003e). It should be noted this model is meant to be used to compare alternatives, not to predict precise resultant water quality.

Assumptions

CBNG development has the potential to impact surface water, surface aquifers and coal seam aquifers that hold the groundwater resources in the planning and CBNG emphasis area. The following assumptions form the framework for analyzing the impacts:

- Under the expanded development RFD, the maximum volume of CBNG water production and discharge is predicted to occur in year six for alternatives B-E. All surface water impacts are calculated using this maximum CBNG discharge volume.

- Under the phased development alternatives (F, G and H), peak water production occurs at a different time for each watershed. Surface water impacts are calculated using the peak for each watershed.

- All modeling results shown in this EIS are for the minimum mean monthly stream discharges. 7Q10 discharges are also included in the SWQATR analysis.

- SAR and EC were calculated using a simple flow-weighted mass balance equation. This assumption is strictly correct for EC however it results in an overestimation of SAR. This results in a conservative model of impacts due to CBNG discharges.

- To facilitate analysis, a range of water quality criteria was assumed based on the proposals before the Montana Board of Environmental Quality. This analysis has been supplemented by incorporation of the current Montana BER approved standards for EC and SAR.

A complete listing of all model assumptions may be found in the SWQATR.

Impacts From Management Common to All Alternatives

Tongue River Railroad

Construction of this railroad would be in accordance with all state and federal rules and regulations and hydrological impacts are expected to be short-lived and minor. The act of construction in the vicinity of the Tongue River riparian zone will increase the local effects of soil erosion. This soil erosion is expected to deliver increased suspended sediment load to the Tongue and its tributaries. Localized erosion and runoff could cause locally increased streamflow in the river tributary and alter stream geometry. Mitigating measures and best management practices are expected to be required in the EIS for the TRR in order to minimize erosion and control runoff velocity. These impacts are anticipated to be of low intensity and of short duration. Sediment yields will return to natural levels once vegetation is reestablished.

Conventional Oil and Gas Production

Conventional oil and gas production can produce large volumes of water that could impact surface and groundwater resources because of the quality of the produced water. Since 1953, the MBOGC has regulated the use and disposal of water produced in association with the production of oil and natural gas to mitigate the potential for impacts to the environment.

The use of surface impoundments is controlled by BLM and the state. BLM permits water disposal pits (surface impoundments) on federal leases. The permitted surface impoundments are those designed primarily for evaporation. Any impoundments constructed in the state, including those involving federal land or minerals, would require approval from the MBOGC. Further, the MDEQ permits any point-source discharges to surface waters (e.g., streams), including those that could result from surface impoundments.

Conventional oil and gas is typically produced from depths below usable aquifers and below coal seams. Regulations require the isolation of oil and gas producing zones from other reservoirs containing possible hydrocarbons or from aquifers that contain usable water. Underground Injection Control (UIC) regulations also require safeguards to isolate injection zones from other zones that contain hydrocarbons and from aquifers that contain usable or potentially usable quality water (i.e., groundwater containing less than 10,000 mg/l of total dissolved solids).

Produced water that has a total dissolved solids (TDS) concentration of less than 15,000 mg/l, can be discharged to permitted surface impoundments. As a result of the existing regulations, the impact on surface water and groundwater resources from conventional oil and gas production is minimal.

CBNG Groundwater Drawdown and Water Mitigation Agreements

Drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. The drawdown of Powder River Basin coal seam aquifers as a result of CBNG production has been modeled several times. The Montana Bureau of Mines and Geology has performed two studies using Montana field parameters—a two-dimensional model (Wheaton and Metesh 2001) and a three-dimensional model (Wheaton and Metesh 2002). In addition, three-dimensional modeling has been carried out using parameters from the Wyoming portion of the Powder River Basin (BLM 1999b).

The maximum lateral extent of drawdown within coal seam aquifers has been estimated by several methods. Monitoring around dewatered coal mines in the Wyoming portion of the Powder River Basin indicates five feet of drawdown extends from 2 to 14 miles from mined areas after 15 years of mining (BLM 1999b). Three dimensional (3D) groundwater modeling conducted in conjunction with the WYODAK EIS (BLM 1999b) predicted five feet of drawdown at distances from 10 to 22 miles from the edge of production. Two dimensional (2D) groundwater modeling, which should represent the maximum limit of drawdown due to vertical leakage being ignored, was conducted in conjunction with this EIS. This 2D modeling indicated that five feet of

drawdown within the Powder River Basin may extend up to 11 miles from the edge of CBNG production (Wheaton and Metesh 2001). 3D groundwater modeling of the East Fork of Hanging Woman Creek was also conducted in conjunction with this EIS. This model indicates the maximum extent of the five-foot drawdown contour extends up to seven miles from the edge of production (Wheaton and Metesh 2002). Based upon this information, the five-foot drawdown contour that would likely result from CBNG development, would extend from 7 to 11 miles from the pumped area. The range of estimates however extends from 2 to 22 miles from the pumped area.

These differences between results are not unexpected and serve to emphasize the site-specific nature of the geology in the Powder River Basin. As the hydrology is fundamentally linked to the geology, it will be critical to manage drawdown-related impacts in an adaptive manner, using site-specific data gathered through monitoring. Management alternatives may include re-supply of water to individuals who have springs or wells affected by drawdown (as required by Montana Code Annotated [MCA] 82-11-175), modification of production plans to limit drawdown impacts to springs where such springs have been determined to be culturally significant or critical to wildlife, or the installation of a hydrologic barrier that will limit the lateral extent of drawdown.

A hydraulic barrier would most likely take the form of a line or system of injection wells. These wells would inject water into the coal aquifer being developed to limit the lateral extent of groundwater drawdown and prevent that drainage of methane and groundwater resources. It should be emphasized the installation of a hydraulic barrier is just one of many methods that may be employed to prevent drainage. The feasibility and necessity of installing such a barrier will be addressed on a case-by-case basis. The water injected by a hydraulic barrier system would most likely be obtained from nearby CBNG production wells completed in the same aquifer as the injection wells. Class V permits for injection of produced water with less than 3, 000 mg/l TDS would generally need to be obtained from EPA Region VIII for such a project. Other permit requirements may apply depending on the quality of the injected water and quality of the water in the target coal seam.

The uncertainty associated with modeling a five-foot drawdown contour is not insignificant since output of this nature is very sensitive to slight changes in the input parameters used for the model. Five feet of drawdown would not, in most cases, impact the usefulness of a well. Since a 20-foot drawdown contour can be modeled with a much higher degree of certainty and it is a more realistic parameter for evaluation of impacts, the 20-foot drawdown contour is used in this analysis to represent the extent of the drawdown which results from CBNG development. Based upon the 3D model prepared in conjunction with this EIS, the 20-foot contour can be expected to extend four to five miles from the edge of CBNG production.

As discussed in Chapter 3, monitoring since the completion of the statewide EIS indicates that "After six years of CBM production, drawdown of up to 20 feet has been measured in the coal seams at a typical distance of roughly one mile and a maximum distance of one and a half miles outside the production areas. These distances are similar to, but somewhat less than predicted in the Montana CBM environmental impact statement." (Wheaton et al. 2006).

Aquifers other than the produced coal seams, such as alluvium or sandstone bedrock aquifers, are less vulnerable to drawdown from CBNG production due to low vertical hydrologic conductivity in the Tongue River member of the Fort Union Formation. This will limit the vertical movement of groundwater (Wheaton and Metesh 2002, Wheaton and Donato 2004). As discussed in Chapter 3, CBNG drawdown has not been observed in units other than the developed coal seams. Groundwater in units below the Tongue River Member of the Fort Union Formation would not be affected by CBNG development since it is underlain by the Lebo Shale, which is an effective aquitard.

Impacts to wells and springs which derive their water from regional flow within the produced coal seams and are located within the drawdown area would take the form of decreased discharge (yield). Few springs in this area obtain their water from regional flow through coal seams (Wheaton and Donato 2004). Most springs are located at the base of clinker ridges and are fed by local flow systems. These locally-fed springs are not expected to be impacted by coal seam aquifer drawdown. Wells are anticipated to have decreased yields as a result of drawdown; however it is not anticipated they would go dry since the coal would continue to be saturated. For example, a typical PRB coal seam well with an initial head 200 feet above the top of the coal could be pumped at a rate of approximately 25 gpm for six hours. If the head were decreased by 20 feet the rate achievable for six hours would drop to approximately 22.5 gpm and if the head were dropped to five feet above the top of the coal the rate would drop to approximately

2.3 gpm. The five feet above the top of the coal is comparable to conditions anticipated within CBNG fields while the 20-foot drawdown contour may extend four to five miles from the edge of CBNG fields (Wheaton and Metesh, 2002).

Although production of CBNG water enhances cleat within the coal seams, it would not propagate vertical fracturing into the adjacent shale confining units.

Recovery of the coal seam aquifers after production ends is a slow process involving recharge from undrained areas of the aquifer, infiltration of precipitation from the surface in areas where the coal aquifers outcrop and the slow process of infiltration from aquifers above and below the produced coal seams (this is expected to take the longest time because of the confined nature of these units).

Modelers assisting the Wyoming BLM determined coal seams that have experienced substantial drawdown also experience recovery as a two-part process:

"After CBNG development (and water removal) ends, within three to four years water levels in the coal aquifers are expected to partially recover to within 20 to 30 feet of pre-operational conditions. Complete water level recovery will be a long-term process, likely requiring hundreds of years for the removed groundwater to be replaced through the infiltration of precipitation" (BLM 2000b).

A similar recovery process is expected to occur in the Montana area of CBNG interest with most of the recovery happening in a short time but full coal seam aquifer recovery requiring hundreds of years. The 3D computer modeling conducted in conjunction with the statewide EIS estimates recovery schedules for methane-productive coal seams, nonproductive coal seams and surface aquifers in Montana. For productive coals within CBNG fields, the aquifers are expected to recover at least 70 percent of their hydrostatic pressure within five to 12 years. Outside the field, productive coals should regain 90 percent of their pressure within three to five years. Nonproductive coals are predicted to regain 80 percent of their pressure within five years. Surface aquifers that are projected to lose only six feet of pressure, would regain 50 percent of that pressure in less than 10 years (Wheaton and Metesh 2002). Precise local groundwater recovery differs depending on site-specific conditions.

Water mitigation agreements are required in Montana under MCA 82-11-175, which was enacted by the Montana legislature in 2003. MCA 82-11-175 requires CBNG operators offer a reasonable mitigation agreement to each person who holds an appropriation right or a permit to appropriate ground water and for which the point of diversion is within one mile of the coal bed methane well; or one-half mile of a well or spring that is adversely affected by the CBNG well.

Mitigation agreements must address the reduction or loss of water resources and must provide for prompt supplementation or replacement of water from any natural spring or water well adversely affected by the coal bed methane well.

MCA 82-11-175 applies to <u>all</u> wells and springs, not just those which derive their water from the developed coal seams and requires "…prompt supplementation or replacement of water from any natural spring or water well adversely affected by the CBNG project…" Adversely affected could include decreased yields, decreased water pressure, increase or sudden appearance of methane, or a change in water quality. Although the terms of water mitigation agreements are to be "under such conditions as the parties mutually agree upon" the replacement of water required by these agreements is anticipated to take the form of reconfiguring existing wells, re-drilling wells, or drilling new wells. These measures would be effective for replacing water sources since drawdown from CBNG activity is anticipated to primarily affect the produced coal seams and to only minimally affect other aquifers (such as sandstones) within the Tongue River Member of the Fort Union Formation. Any lost or diminished water sources or adversely affected groundwater would be anticipated to be replaced with a permanent source before the termination of the agreement. It is recognized that additional costs (power, moving irrigation piping, etc.) may be associated with the reconfiguration, redrilling, or replacement of impaired water wells and those additional costs are typically paid for by the operator as outlined in the agreements. Furthermore, if a replacement well were required, a *Replacement Well Water Right* might be issued by DNRC, which would retain the priority date of the original well. An example water mitigation agreement is included in the Hydrology Appendix.

The owners of water sources are also protected from impacts from CBNG through the Coal Bed Methane Protection Act (MCA 76-15-9). This act provides for the establishment of the Coal Bed Methane Protection Account which can only be used to compensate landowners and water right holders for damages attributable to coal bed methane development. The text of MCA 76-15-9 is included in the Hydrology Appendix.

As such, the impacts due to ground water drawdown are mitigated by existing state requirements. It should

be noted drawdown itself is not eliminated; however affected parties have multiple means by which to be made whole.

Impacts from Management Specific to Each Alternative

Impacts on Hydrological Resources under the management alternatives are summarized in Chapter 2, Table 2-3, Comparison Summary of Impacts. The impacts are discussed in detail for the major watersheds in the following sections.

Alternative A—No Action (Existing CBNG Management)

Alternative A consists of the existing (2003) CBNG management scenario, with the addition of the forecasted future development of CBNG resources in the Wyoming portion of the Powder River Basin that occurs upstream of Montana. The Wyoming BLM has adopted Wyoming's Alternative 2A for CBNG water management (BLM 2003d).

Under Montana's Alternative A, only those producing wells that currently exist in the CX Ranch field will produce CBNG and water in Montana. Other CBNG exploration wells could be drilled on state and private minerals, but would not be allowed to produce gas or water. Rosebud Creek, the Bighorn River and Mizpah Creek would not receive any CBNG produced water under this alternative, as they would not be affected by Wyoming's production. However, an analysis of their flow volumes and water chemistries are included for comparison to other alternatives. The Tongue River, Powder River and Little Powder River watersheds could have impacts from CBNG development due to Wyoming production.

Exploration

CBNG exploration activities on state, private, or BLM-administered mineral estates would result in only slight effects on groundwater and would not affect surface waters. Exploration wells would be tested but not commercially produced. Testing of CBNG exploration wells involves pumping the wells for several weeks; however, the volume of coal seam aquifer groundwater removed is moderate and is not expected to impact nearby water wells or springs. Recovered produced water and drilling wastes would be contained in impoundments or tanks and would be disposed of in accordance with regulations for conventional oil and gas wastes.

Production

CBNG water production would continue to be allowed within the CX Ranch CBNG field, but at a level approximately 20 percent above current conditions; this would constitute a total of 250 producing wells. An increase in soil erosion resulting from the construction of additional well pads and lease roads could occur, adding to the suspended sediment load of area surface waters.

The 250 producing CBNG wells at the CX Ranch field would also affect groundwater resources within the producing coal seam aquifers. Production at this level would result in increases to groundwater drawdown levels within the three coal seam aquifers being produced. Groundwater drawdown within the coal seams currently extends approximately one mile beyond the edge of CBNG production at the CX Ranch field (Wheaton et al. 2006). Increasing the size of the field by approximately 20 percent would add to the drawdown.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Water released to unlined surface impoundments may infiltrate into shallow aquifers, causing measured impacts to the groundwater. The introduction of this water into the aquifer may improve or degrade the usability of these waters, depending on site specific conditions. In general, it would be anticipated that over the short term (<5 years), as soluble salts (calcium-magnesium (Ca-Mg) sulfates) are dissolved from the flow path, the infiltration of this water will cause an increase in EC and a decrease in SAR within the immediate vicinity of the impoundment. Over the long term (>5 years), after soluble salts are flushed from the system, the continued infiltration of this water would cause a decrease in EC and an increase in SAR. These impacts will be localized; however the precise geographic extent will depend on site specific conditions.

Surface Water Analysis

Tongue River

The Tongue River has its headwaters in the Bighorn Mountains to the south. This river could receive CBNG impacts from current and future development in both the Wyoming and Montana portions of the

TABLE 4-33

EFFECTS ON SURFACE WATERS OF THE TONGUE RIVER UNDER ALTERNATIVE A

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Tongue River at Stateline Near Decker	3	1,000	5	1,500	178	0.86	731	183	1.93	773
Tongue River Near Birney Day School	3	1,000	5	1,500	183	1.09	863	190	2.52	912
Tongue River at Brandenburg Bridge Near Ashland, Montana	3	1,000	5	1,500	207	1.36	1,016	214	2.5	1,058

Powder River Basin. The detailed input data, calculation of impacts and summary of impacts from Alternatives can be reviewed in the SWQATR. Table 4-33 displays the impacts for the three stream stations analyzed along the Tongue River in Montana. It is assumed that approximately 15 percent of the water discharged into impoundments in the Wyoming portion of the Tongue River watershed would reach the Tongue River. In addition, other impacts to the Tongue River under Alternative A could result from the approximately 250 CBNG wells in the CX Ranch field. For this analysis, the CX Ranch discharge was split between the Decker station and the Birney station.

During the minimum mean monthly flow, these impacts increase the flow volume and EC value in the stream by only a few percentage points, but increase the SAR value in the river water by up to 133 percent (1.4 units). The resultant mixed stream water and CBNG water can be compared to the following surface water criteria:

- Northern Cheyenne Standards: Surface water alteration forecasted under Alternative A would be at or below the tribe's proposed limits during the irrigation season (April through October) but would exceed the proposed standard for SAR during the non-irrigating season by up to 0.52 SAR.

- Ayers and Westcot: The SWQATR displays the SAR versus EC plots for the Tongue River. These plots show that at no time would water cause infiltration impacts to soils under irrigation under Alternative A.

- MDEQ Irrigation Season Standards (Mt-Irr): These standards are set at a SAR of 3.0 and an EC of 1000 micro-Siemens per centimeter (µS/cm) for the Tongue River. The forecast surface water quality under Alternative A during minimum mean monthly flows is below these standards for all stations and below these EC standards for all stations except for the station at Brandenburg Bridge. Existing conditions at Brandenburg Bridge during minimum mean monthly flows are also in excess of this standard. The 40 percent non-degradation analysis threshold for EC (400 µS/cm) is exceeded by existing conditions and the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (1.2) is exceeded by existing conditions at the Brandenburg station and the resulting surface water quality would cause it to be exceeded at all stations.

- MDEQ Non-Irrigation Season Standards (Mt-Non): These standards are set at a SAR of 5.0 and an EC of 1500 µS/cm for the Tongue River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is below these SAR and EC standards for all stations. The 40 percent non-degradation analysis threshold for EC (600 the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (2) is greater than existing conditions and the resulting surface water quality would cause it to be exceeded at the Birney Day School and Brandenburg stations.

- The 40-percent increase of minimum mean monthly flow analysis threshold (40 percent

MMM): This analysis threshold is not exceeded for any station.

Under Alternative A the surface water quality in the Tongue River would be slightly altered by CBNG development in Wyoming and the untreated discharge occurring in Montana under an existing permit. The numerical standards, which were developed to protect beneficial uses, are not exceeded except for EC at the Brandenburg station. The EC at the Brandenburg station also exceeds this standard under existing conditions. Therefore, it is not anticipated beneficial uses will be altered.

Discharges of CBNG water would only slightly increase surface water flow in the Tongue River, causing negligible changes to physical stream conditions, even during historically low-flow periods.

Powder River

The Powder River has its headwaters in the Wyoming portion of the Powder River Basin and as such would receive CBNG water from development in Wyoming. As no Montana CBNG wells are assumed to discharge into the Powder River under Alternative A, all forecasted alterations would be due to CBNG development in Wyoming. The analysis conducted at the Locate, Montana station includes all CBNG discharges into the Powder, Little Powder and Mizpah, cumulatively. Table 4-34 summarizes these impacts. During MMM flows the Powder River is expected to be affected by Wyoming CBNG development, resulting in an appreciable alteration of surface water chemistry. Only Wyoming CBNG development would affect the river. Flow volumes are forecasted to increase by approximately 54 percent SAR would be increased by approximately 130 percent and EC would be increased by 3 to 4 percent. The resultant mixed stream water quality can be compared to the available surface water criteria:

- Ayers and Westcot: The SWQATR includes SAR vs. EC plots to document that the resultant water quality during minimum mean monthly flows will not cause infiltration impacts to soils under irrigation.

- MT-Irr: These standards are set at a SAR of 5.0 and an EC of 2,000 µS/cm for the Powder River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is above the SAR and EC standards. Existing conditions also exceed this EC standard. As such, permitted discharges in Wyoming may have to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standard. The 40 percent non-degradation analysis threshold for EC (800 µS/cm) and SAR (2) are exceeded by existing conditions and the resulting surface water quality would increase these exceedances.

- MT-Non: These standards are set at a SAR of 6.5 and an EC of 2,500 µS/cm for the Powder River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is above this SAR standard and below the EC standard. As such, permitted discharges in Wyoming may need to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standard. The 40 percent non-degradation analysis threshold for EC (1000 µS/cm) and SAR (2.6) are exceeded by existing conditions and the resulting surface water quality would increase these exceedances.

- 40 percent MMM: This analysis threshold would be 203 cfs at Moorhead and 200 cfs at Locate. This is exceeded for both stations by discharges in Wyoming.

TABLE 4-34

EFFECTS ON SURFACE WATERS IN THE POWDER RIVER UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min, Mean Monthly)			Resulting Stream Water Quality and Quantity (Min, Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Powder River at Moorhead	5	2000	6.5	2500	145	4.65	2154	224	10.7	2230
Powder River at Locate	5	2000	6.5	2500	143	4.61	2287	236	11.36	2320

Under Alternative A the surface water quality in the Powder River would be noticeably altered by CBNG development in Wyoming. Flows would also substantially increase, potentially leading to noticeable changes to physical stream conditions. The numerical standards for EC and SAR, which were developed to protect beneficial uses, are exceeded at all stations. The EC standards are also exceeded by existing and historic ambient conditions. As such, permitted discharges in Wyoming may need to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standards.

The Little Powder River

The Little Powder River has its headwaters in the Wyoming portion of the Powder River Basin and as such it is expected to receive CBNG water from development in that state. All analyses for this stream are conducted at the Weston, Wyoming, station, near the stateline. At this station, no effects are possible from Montana CBNG under any alternative; however Montana CBNG discharges are addressed by the cumulative analysis of the Powder River at Locate. Table 4-35 illustrates the effects expected on the Little Powder River from CBNG development under Alternative A.

Only Wyoming CBNG discharges affect the river under this alternative. During minimum mean monthly flows, this development will cause the flow to increase by 515 percent, the EC to decrease by 51 percent and the SAR to increase by 50 percent. The resultant mixed stream water and CBNG water can be compared to the following surface water criteria:

- Ayers and Westcot: The SWQATR plots suggest that during the mean monthly flows for 2 months of the year (November and December) the mixed water may cause infiltration impacts to soils under irrigation. The elevated SAR may reduce soil permeability, thereby reducing the rate of water infiltration.

- MT-Irr: These standards are set at a SAR of 5.0 and an EC of 2,000 µS/cm for the Little Powder River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is well above the SAR standard and below the EC standard. Existing conditions exceed the SAR and EC standards. As such, permitted discharges in Wyoming may need to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standard. The 40 percent non-degradation analysis threshold for EC (800 µS/cm) is exceeded by existing conditions and the resulting surface water quality would decrease this exceedance. The 40 percent non-degradation analysis threshold for SAR (2) is exceeded by existing conditions and the resulting surface water quality would increase this exceedance.

- MT-Non: These standards are set at a SAR of 6.5 and an EC of 2,500 µS/cm for the Little Powder River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is well above this SAR standard and below the EC standard. Existing conditions exceed the SAR and EC standards. As such, permitted discharges in Wyoming may need to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standard. The 40 percent non-degradation analysis threshold for EC (1000 µS/cm) is exceeded by existing conditions and the resulting surface water quality would decrease this exceedance. The 40 percent non-degradation analysis threshold for SAR (2.6) is exceeded by existing conditions and the resulting surface water quality would increase this exceedance.

TABLE 4-35

EFFECTS ON SURFACE WATERS OF THE LITTLE POWDER RIVER UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Little Powder above Dry Creek	5	2000	6.5	2500	3	6.9	3300	16	10.4	1606

- 40 percent MMM: This analysis threshold would be 4.6 cfs at Weston. This is exceeded by forecast Wyoming discharges, with the result being 16 cfs.

Under Alternative A the surface water quality in the Little Powder River would be noticeably altered by CBNG development in Wyoming. The numerical standards for EC and SAR were developed to protect beneficial uses. The numerical EC standard is exceeded by existing conditions, but would not be exceeded by forecasted conditions. The numerical SAR standard is exceeded by existing conditions and this exceedance would be increased by forecasted conditions. As such, permitted discharges in Wyoming may need to be managed differently than assumed under Wyoming's Alternative 2A in order to be in compliance with the Montana standards.

Wyoming discharges of CBNG water would increase surface water flow into the Little Powder River by more than six times, causing major changes to stream conditions including increased flow, channel erosion and sedimentation during historically low-flow periods.

Mizpah Creek

The Mizpah contains low quality water that has limited irrigation use, but can be used for stock watering and wildlife. This watershed is not expected to be affected by CBNG activity under Alternative A, as shown on Table 4-36. This stream water can be compared to the following surface water criteria:

- Ayers and Westcot: Except for 3 months out of the year, the average existing water exceeds irrigation water quality limits set by Ayers and Westcot.
- MT-Irr: These standards are set at a SAR of 3.0 and an EC of 500 µS/cm for tributaries of the Powder River. Existing surface water quality during minimum mean monthly flows is above these SAR and EC standards. The 40 percent non-degradation analysis thresholds for EC (200 µS/cm) and SAR (1.2) are also exceeded by existing conditions.
- MT-Non: These standards are set at a SAR of 5.0 and an EC of 500 µS/cm for tributaries of the Powder River. Existing surface water quality during minimum mean monthly flows is above these SAR and EC standards. The 40 percent non-degradation analysis thresholds for EC (200 µS/cm) and SAR (2) are also exceeded by existing conditions.
- 40 percent MMM: This analysis threshold would be 0.36 cfs at Mizpah. No discharge is forecast in this watershed under this alternative.

All current uses of these waters would be maintained under Alternative A.

Bighorn and Little Bighorn Rivers

These rivers carry high quality water from the Bighorn Mountains north into Montana. No CBNG wells in Wyoming or Montana are expected to impact these rivers under Alternative A. Stream water quality and flow volume are expected to remain unchanged. As shown on Table 4-37, the following expected results can be compared to the following surface water quality criteria:

- Ayers and Westcot: The monthly average existing water quality at all three stations is within irrigation water quality limits set by Ayers and Westcot.

TABLE 4-36

EFFECTS ON SURFACE WATER OF MIZPAH CREEK UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Mizpah Creek at Mizpah	3	500	5	500	0.26	16.6	3503	0.26	16.6	3503

TABLE 4-37

EFFECTS ON SURFACE WATERS OF THE LITTLE BIGHORN AND BIGHORN RIVERS UNDER ALTERNATIVE A

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Little Bighorn River at Wyola	N/A	N/A	N/A	N/A	110	0.53	548	110	0.53	548
Little Bighorn at Hardin	N/A	N/A	N/A	N/A	123	0.99	768	123	0.99	768
Bighorn River at Bighorn	N/A	N/A	N/A	N/A	1523	2.08	952	1523	2.08	962

- EC and SAR standards have not been developed for these waters.
- 40 percent MMM: This analysis threshold would be 154 cubic feet per second (cfs) at Wyola, 172 cfs at Hardin and 2132 cfs at Bighorn. No discharge is forecast in this watershed under this alternative.

All current uses of these waters would be maintained under Alternative A.

Rosebud Creek

This creek drains part of the Powder River Basin in Montana. No CBNG water would be discharged into this creek; therefore, stream water quality and flow is unchanged as shown on Table 4-38. These expected results can be compared to the following surface water quality criteria:

- Ayers and Westcot: The monthly average existing water quality at both stations is within irrigation water quality limits set by Ayers and Westcot.
- MT-Irr: These standards are set at a SAR of 3.0 and an EC of 1,000 µS/cm for Rosebud Creek. Existing surface water quality during minimum mean monthly flows is above the SAR standard at the Rosebud station and above the EC standard for both stations. The 40 percent non-degradation analysis threshold for EC (400 µS/cm) is exceeded at both stations. The 40 percent non-degradation analysis threshold for SAR (1.2) is exceeded by existing conditions at the Rosebud station.
- MT-Non: These standards are set at a SAR of 5.0 and an EC of 1500 µS/cm for Rosebud Creek. Existing surface water quality during minimum mean monthly flows is below the SAR standard for both stations and above the EC standards for the Rosebud station. The 40 percent non-degradation analysis threshold for EC (600 µS/cm) is exceeded at both stations. The 40 percent non-degradation analysis threshold for SAR (2) is exceeded by existing conditions at the Rosebud station.
- 40 percent MMM: This analysis threshold would be 2.5 cfs at Kirby and 11.8 cfs at Rosebud. No discharge is forecast in this watershed under this alternative.

All current uses of these waters would be maintained under Alternative A.

Yellowstone River

The Yellowstone River drains all of the Montana watersheds in the Powder River Basin. As such it provides an analysis of the cumulative effects forecasted from CBNG development in Montana and Wyoming in the Bighorn, Rosebud, Tongue, Powder and Yellowstone watersheds.

Only the station at Sidney is expected to receive CBNG related effects under Alternative A. These effects are in the form of discharge from CX Ranch in Montana and Wyoming CBNG wells. After mixing, the flow of the Yellowstone would be increased by 1 percent, the SAR would be increased by 13 percent and the EC would be increased by 1 percent. The resultant mixed stream water, shown on Table 4-39, can be compared to the following surface water criteria:

TABLE 4-38

EFFECTS ON SURFACE WATER OF ROSEBUD CREEK UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Rosebud Creek at Kirby	3	1000	5	1500	1.78	0.77	1016	1.78	0.77	1016
Rosebud Creek at Rosebud	3	1000	5	1500	8.42	4.84	1780	8.42	4.84	1780

TABLE 4-39

EFFECTS ON SURFACE WATER OF THE YELLOWSTONE RIVER UNDER ALTERNATIVE A

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Yellowstone at Forsyth, Montana	N/A	N/A	N/A	N/A	5820	1.99	745	5820	1.99	745
Yellowstone at Sidney, Montana	N/A	N/A	N/A	N/A	5764	2	870	5805	2.26	881

- Ayers and Westcot: The SWQATR's plots predict that the mixed water would not cause infiltration impacts to soils under irrigation under Alternative A.
- EC and SAR standards have not been developed for these waters.
- 40 percent MMM: This analysis threshold would be 8148 cfs at Forsyth and 8070 cfs at Sidney. This analysis threshold is not exceeded for either station.

Under Alternative A the surface water quality in the Yellowstone River would be slightly altered by CBNG development in Wyoming and the untreated discharge occurring in Montana under an existing permit. The numerical standards, which were developed to protect beneficial uses, are not exceeded. Therefore, it is not anticipated that beneficial uses will be altered.

Discharges of CBNG water would only slightly increase surface water flow in the Yellowstone River, causing negligible changes to physical stream conditions, even during historically low-flow periods.

Abandonment

Abandoned well pads would be restored to their original condition with the only effect being the short-term increase in suspended sediments in area surface waters resulting from the increased erosion of disturbed soil. CBNG wells that are not produced would be abandoned in accordance with existing regulations and with procedures for the abandonment of oil and gas wells to protect groundwater resources, or converted to monitoring wells as deemed necessary.

Crow Reservation

The Crow Reservation can expect few effects from CBNG development within Montana under this alternative. Continued development is expected in the CX Ranch field near Decker. Groundwater drawdown is expected to extend approximately 4-5 miles from the CX Ranch development. This

drawdown could impact water wells and springs that receive water from these coal seams on tribal land. Scattered CBNG exploration drilling and testing would have only slight effects on reservation coal seam aquifers.

CBNG development in Montana and Wyoming could drain groundwater and methane from coal seams under the Reservation.

If Wyoming CBNG operators are able to discharge CBNG water into either the Little Bighorn or Bighorn watersheds, there could be effects to surface waters on the Reservation. However, there are currently no proposals to develop CBNG in these watersheds in Wyoming.

Northern Cheyenne Reservation

The Northern Cheyenne Reservation can expect effects to surface water by CBNG development outside the reservation under this alternative. The CX Ranch has a permit to discharge CBNG water to the Tongue River and this would continue under this alternative. Effects to surface water are described in detail in the surface water section of this alternative and in the SWQATR. Groundwater drawdown is expected to extend approximately four to five miles from the CX Ranch development. This groundwater drawdown effect would not reach the Northern Cheyenne Reservation.

CBNG development in Wyoming is not expected to affect groundwater under the Reservation. Permitted outfalls, accidental releases and unintended infiltration under storage ponds could contribute some effect to the Tongue River from Wyoming.

Conclusion

Montana-based CBNG development, conventional oil and gas development, the Tongue River Railroad and surface coal mining would have the potential for effects to surface water and coal seam aquifer groundwater resources in Montana. Few CBNG wells would be drilled and impacts would be limited in both magnitude and geographic extent. CBNG development at the CX Ranch field could expand, although surface discharge volume to the Tongue River would be controlled by an existing permit. Groundwater impacts to methane-productive coal seam aquifers from the CX Ranch are expected to extend 4-5 miles from the edge of development. Scattered CBNG exploration and testing would have a slight effect on static water levels in coal seam aquifers, but would not affect surface waters.

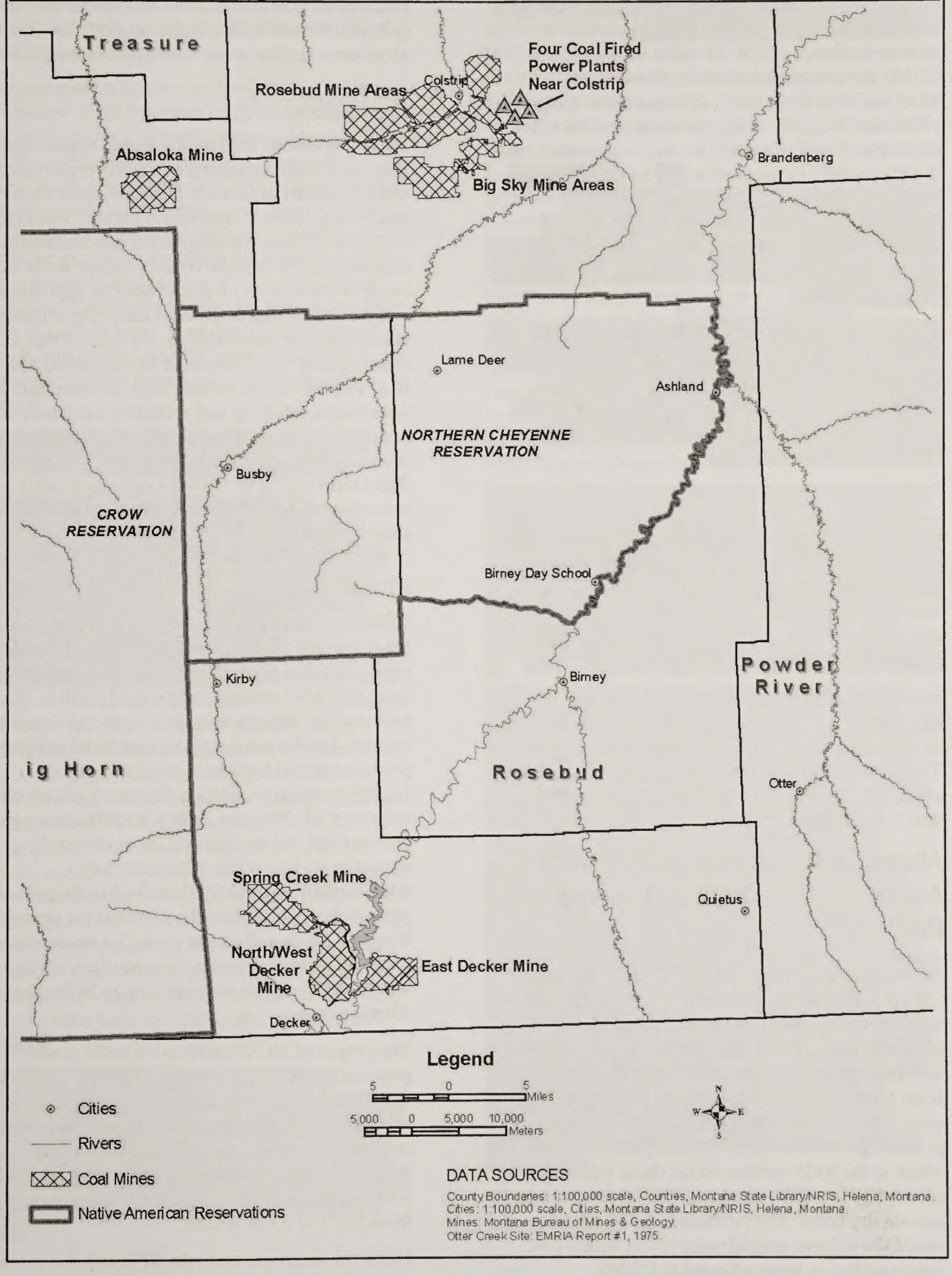
Coal seams that are the targets of surface coal mining operations typically contain groundwater. As a result of the presence of this water, coal mine operators must remove this water as it collects in the bottom of the pits in order to mine the coal. Map 4-2 shows coal mines in the Planning Area. These mines cover approximately 50,000 acres where coal seam aquifers have been impacted either by the removal, partial depletion, or total depletion of groundwater. In the mining areas around Colstrip and Decker, coal seam aquifers have been drawn down by as much as 75 feet near the coal mines, with a radius of impact of up to 4 miles from the mines (Wheaton and Metesh 2001). The discharge of groundwater pumped from mine pits would also affect surface water depending on the quality of groundwater near the mine and the quantity of groundwater discharged. In instances where the mines do not discharge because all of the recovered groundwater is used, there would be no direct impacts to surface water quality. Much of the groundwater pumped from the mine pits would be stored and used to control dust on roads, truck and train car loading areas and the mine face.

Following the release of the Wyodak EIS (BLM 1999b), the RFD for the Wyoming portion of the Powder River Basin was reassessed and a new RFD was issued (BLM 2001a). This more recent study indicates that the total number of CBNG wells in the Wyoming portion of the Powder River Basin may approach 50,000 (BLM 2001a). An EIS using this level of development has been completed for Wyoming.

Groundwater resources in Montana's coal seam aquifers could be affected by CBNG production in Wyoming. CBNG-producing wells in northern Wyoming would cause a drawdown of coal aquifers on adjacent land, with groundwater drawdown possibly extending northward into Montana. If CBNG fields were located in Wyoming adjacent to the border with Montana, it can be expected that groundwater levels within coal seam aquifers would be drawn down 20 feet at 4-5 miles into Montana. Drawdown impacts of this magnitude would result in impacts on private lands, the Crow Reservation, state-owned lands and federal lands controlled by BLM. Cumulative groundwater impacts to coal seam aquifers would be largest near CX Ranch and close to the Wyoming border.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Map 4-2: Location Map, Regional Coal Mines



The numerical surface water quality limits adopted by the Montana Board of Environmental Review are enforceable upstream under the CWA. As such, both Montana and Wyoming may need to curtail the surface discharge of CBNG water. If Wyoming CBNG development reaches expected levels, Montana watersheds could be impacted to the point where water quality standards could prohibit CBNG discharge. For this impact analysis, it is assumed that the Wyoming Alternative 2A will be implemented; however in some watersheds development in Wyoming may need to proceed differently than assumed under Wyoming's Alternative 2A in order to ensure that Montana's surface water quality standards are not exceeded.

The Montana BER's rule change which made EC and SAR harmful parameters has not been approved by the EPA and so it does not have CWA standing; however if this change is approved by EPA further modification of water management practices in Wyoming would be needed.

Surface water discharge permits that limit the quantity and quality of discharged CBNG water are required in Montana and Wyoming. This permitting process, which incorporates the numerical and non-degradation standards, would mitigate the impacts from Wyoming CBNG production and from expanded CX Ranch production since permitted discharges must be in compliance with the CWA.

Beneficial reuse of CBNG water is expected to continue in the vicinity of the CX Ranch field as well as other areas near the Wyoming-Montana border. The increased flow of water in some streams may allow increased utilization of the mixed water if quality is appropriate.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Alternative B consists of full-scale development of CBNG with water produced from CBNG exploration wells stored in tanks or impoundments and all water produced from CBNG production wells to be injected into approved subsurface zones other than the coal seam from which it was produced. No CBNG water would be discharged to the surface. The number of producing CBNG wells being analyzed is 16,500, which is the RFD number minus those wells not covered by this EIS (tribal and USFS wells) minus 10 percent dry holes. The estimated 16,500 CBNG wells would draw down groundwater levels within coal seam aquifers in areas adjacent to CBNG development, affecting water wells and springs that draw water from the productive coal seams. The construction of well pads and lease roads would result in surface disturbances that would increase the potential for soil erosion, consequently increasing short-term surface water suspended sediment loads.

Exploration

Full-scale CBNG exploration would require water generated from the testing of CBNG exploration wells be stored in tanks or impoundments on state and federal lands. Construction permits would require measures to reduce leakage from impoundments. The estimated 2,000 dry CBNG exploration wells would result in the short-term disturbance of approximately 2,000 acres of land at the well sites. These disturbed acres would be vulnerable to soil erosion that would cause run-off water impacted by suspended sediment. BMPs to curtail soil erosion such as water bars across lease roads, relieving and mulching cut-banks and restoration of the surface would serve to mitigate erosion related effects to surface water resources. Short-term testing of CBNG exploration wells would not substantially affect static water levels of area coal seam aquifers

Production

CBNG production is expected to be concentrated in the Powder River Basin, but could also develop locally in other portions of the state. This full-scale level of CBNG development would result in the potential for impacts to surface water resources from increased soil erosion and the accidental releases of produced water. Full-scale development of 16,500 producing CBNG wells would disturb an estimated 54,000 acres, which would increase the potential for soil erosion and the corresponding impact to surface water. However, the implementation of BMPs described in the preceding paragraph would reduce the potential for impacts from soil erosion. Because produced water would be disposed by injection into deep aquifers, surface water quality effects are predicted to be the same as Alternative A.

The projected 16,500 production wells would generate an estimated average of 2.9 billion cubic feet of produced water per year over 20 years. CBNG water produced in Montana is expected to be similar in chemistry to Wyoming CBNG water. The produced water would be expected to have a range of SAR values from 22 to 47 and EC values ranging from 2,077 to 3,042 µS/cm.

Using the assumptions in the RFD and the extrapolated discharge trend line, it is calculated that

the maximum annual volume of produced water would occur in year 6 of the plan. During year six, 7,750 wells would be producing with an average rate of 6.2 gpm per well, for a total volume of 3.4 bcf of produced water in that year.

Water management options under this alternative would consist of the injection of CBNG-produced waters into approved subsurface zones. No discharge of CBNG waters would be allowed. Some of the produced water would be temporarily stored in tanks or impoundments prior to injection. These facilities could fail, causing localized impacts to surface water and shallow groundwater. The implementation of BMPs concerning the location and construction of these impoundments would mitigate the potential for impacts to surface water from the stored produced waters. Berms around tank batteries would reduce the potential for impacts from leaks and catastrophic failures.

Localized impacts from impoundments would be similar to those described under Alternative A.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts. During the 20-year planning period for CBNG production, groundwater levels within coal seam aquifers could be drawn down over large, contiguous areas of the state. For example, the Upper Tongue watershed covers 590,000 acres and could hold 5,800 CBNG wells as projected in the RFD. Over the life of the project approximately five percent of the groundwater in the coal seam aquifers could be lost to CBNG production in this watershed. Following methodology detailed in the *Water Resources Technical Report* (ALL 2001b), potential CBNG-producing wells per watershed and potential coal seam aquifer groundwater production estimates for 20 years of production for each of the watersheds have been calculated and are listed in Table 4-40.

In those portions of Montana where CBNG is developed outside of the Powder River Basin, CBNG production is not expected to be as concentrated and hydrological impacts would be less. Limited CBNG production in these areas would result in the localized drawdown of groundwater levels within coal seam aquifers.

An estimated 2.9 bcf of produced water would be injected into deep aquifers annually throughout the state. This process would not affect coal seam aquifers. The injection of CBNG-produced water has not been conducted in Montana, but is commonplace for waters produced from conventional oil and gas activities. In the year 2000, the state of Montana averaged 847 injection/disposal wells that disposed of 0.6 billion cubic feet of water every year (average injection of 128,000 bbl of water per well per year). Injection of CBNG water under this alternative is estimated to increase the number of injection wells to nearly 3,000. These new CBNG injection wells would have an average injection rate of 265,000 barrels of water per well per year. This water would either be injected into shallow aquifers with compatible water quality or into deep aquifers, whose water is not fit for use. Given the effectiveness of current injection regulations, the increase in injected volume resulting from CBNG production is anticipated to have only a minimal effect on surface water or groundwater resources.

The major limitation to injection will be the presence of suitable injection zones. As discussed in Chapter 3, within particular study areas it has been shown suitable shallow sand injection targets underlie approximately 9 percent of the area (Wheaton and Reddish 2005). Injection zones need to be able to transmit water away from the injection well and store it.

Thick channel sandstones and undeveloped coals within the Fort Union Formation are expected to have sufficient transmissivity, would maintain the water quality and would allow the water to be retrieved in the future. Injection into these shallow zones may be limited due to the injection zones already being saturated and pressurized and sandstones being lenticular in nature. These shallow zones may also contain water wells, monitoring wells and boreholes which would provide conduits to the surface for the injected water. Because these zones are shallow the fracture pressure of the zone is low and will not allow much pressure to be applied while injecting, this would limit the amount of water that could be forced into the zone. If the fracture pressure of the zone was exceeded the injected water may be forced into other zones and to the surface through water wells or monitoring wells. These factors may cause these zones to be limited in the volume of water that they may accept.

TABLE 4-40

GROUNDWATER DEPLETION BY CBNG DEVELOPMENT IN THE MONTANA POWDER RIVER BASIN

Watershed	Potential CBNG Producing Wells	Potential Produced CBNG Water in 20 years (billion cubic feet)
Little Big Horn	675	2.5
Little Powder	200	0.7
Lower Bighorn	800	2.8
Lower Tongue	3,450	12.0
Lower Yellowstone	1,700	6.0
Middle Powder	2,100	7.4
Mizpah	125	0.5
Rosebud	3,600	12.6
Upper Tongue	3,850	13.5
Total	**16,500**	**58.0**

Note: Calculated maximum potential coal seam aquifer groundwater production by watershed (billion cubic feet) after 20 years of CBNG production. Details on the method used to calculate these numbers can be obtained from the *Water Resources Technical Report* (ALL 2001b).

Deeper injection zones, such as the Madison Formation, are expected to have sufficient transmissivity and storativity to accept the water; however the saline nature of the existing water in these zones would degrade the injected water to the point where it could not be retrieved and used. The depth to these zones would also prohibit the recovery of the water resource. Injection into deep zones may also be prohibitively expensive, resulting in less CBNG development than predicted in the RFD.

Abandonment

When the estimated 16,500 production wells are abandoned throughout the life of the resource in the Planning Area, 33,000 acres of soil would be disturbed for a short time period. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would mitigate the potential for impacts to surface water resources resulting from soil erosion until groundcover and original site conditions are restored. CBNG wells that are not produced, or have reached the end of their productive life would be abandoned in accordance with existing regulations and procedures for the abandonment of oil and gas wells to protect groundwater resources, or converted to monitoring wells, as deemed necessary.

Crow Reservation

Surface water effects on Crow Tribal Lands under Alternative B would include those impacts noted in Alternative A. Additional impacts from suspended sediment due to soil erosion and runoff from the disturbed acreage are expected near the Crow Reservation from the development of private land within the exterior boundaries of the Crow Reservation, or from development of CBNG on tribal Lands.

Groundwater impacts would include those detailed in Alternative A as well as additional impacts from nearby wells. The tribe can expect 20 feet of drawdown in coal seam aquifers from CBNG wells to extend 4 to 5 miles from CBNG wells near the Reservation boundaries towards the later part of the 20 year production period. The drawdown in producing coal seams may be as high as 10 feet for wells within one to two miles of the boundary during the early stages of production. This drawdown would affect water wells and springs within the reservation that derive water from productive coal seam aquifers.

In addition, because of the large presence of private land within the exterior boundaries of the Crow Reservation, CBNG development on those non-reservation lands could also affect surface water and groundwater in a manner consistent with other areas of the Powder River Basin. The development of CBNG on private lands within the reservation boundary could result in increased suspended sediment loads from surface disturbances in the

Bighorn, Little Bighorn, Rosebud and Squirrel Creek watersheds.

Northern Cheyenne

Surface water effects on Northern Cheyenne Tribal Lands under Alternative B would include those impacts noted in Alternative A. Additional effects are expected from suspended sediment as a result of soil erosion and runoff from the area upstream of the Northern Cheyenne Reservation. Increased sediment loads would affect both the Tongue River and Rosebud Creek watersheds resulting from the surface disturbances associated with CBNG development. Groundwater drawdown effects on the reservation would be similar to impacts in other areas of the Powder River Basin. The tribe can expect up to 20 feet of drawdown to extend four to five miles in the produced coal seam aquifers from CBNG development near the reservation boundary. This drawdown would affect water wells and springs within the reservation that derive water from the produced coal seam aquifers.

Conclusion

Impacts on surface water and groundwater as a result of Wyoming CBNG development, coal mines and the Tongue River Railroad would be same as discussed under Alternative A. Impacts on surface water would include those impacts listed under Alternative A plus the impact of suspended sediment generated by soil erosion taking place near CBNG development. There would be no substantial increase in surface water flow beyond what was described for Alternative A because all CBNG produced water in Montana would be managed by injection.

CBNG production in Montana under Alternative B would result in the withdrawal of approximately five percent of the groundwater resources contained within the producing coal seams and approximately 0.1 percent to 0.2 percent of the total recoverable groundwater resources that underlie Montana's portion of the Powder River Basin. This withdrawal estimate was derived from Specific Storage values ($3x10^{-4}$ to 9×10^{-4}) from modeling (Wheaton and Metesh 2002) assuming an average of 70 feet of coal and a drawdown of 200 feet needed to release economic volumes of methane. Water wells completed in the developed coals near CBNG fields could experience drops in static water levels.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Alternative C—Emphasize CBNG Development

Alternative C consists of the direct discharge of CBNG-produced waters to the land surface. Impacts to water resources resulting from this alternative would consist of coal seam drawdown-related effects similar to Alternative B and effects due to the large volume of CBNG water being discharged to the ground and allowed to flow into drainages and water bodies.

Discharge to the ground would cause increased soil erosion between the discharge point and the nearest drainage. There would be a corresponding increase in the suspended sediment load in surface waters adjacent to CBNG development. As CBNG water flows along drainages, infiltration of the water would occur, resulting in rising shallow groundwater elevations and shifts in the chemistry of the shallow groundwater. These shifts in groundwater chemistry may improve or degrade the usability of the groundwater, depending on site-specific conditions. In general it would be anticipated that over the short term, as soluble salts (Ca-Mg sulfates) are dissolved from the flow path, the introduction of this water would cause an increase in EC and a decrease in SAR. Over the long term, when the soluble salts are flushed from the system, the continued infiltration of this water may cause a decrease in EC and an increase in SAR since the CBNG water typically has an EC less than the alluvial groundwater and an SAR greater than the alluvial groundwater. The infiltrated water would flow downgradient in the alluvial aquifers until a perennial waterway is reached. In gaining streams, this groundwater would be discharged to surface waters. Within the PRB most streams are losing streams, with alluvial groundwater levels below the base of the streams which results in surface water infiltrating into the groundwater.

CBNG water that does not infiltrate or evaporate en route would reach perennial waterways as point discharges. The addition of CBNG water to drainages and surface water bodies, through both point and diffuse discharges, would result in increased flow volumes and changes in water chemistry. These changes would, in turn, lead to loss of soil structure, increased erosion rates and increased suspended sediment loads. The chemistry of the surface waters would also potentially impact some uses by humans and wildlife.

Exploration

Impacts would be similar to those described in the Alternative B discussion. The moderate volume of water generated by the testing of CBNG exploration wells would be stored in tanks or impoundments to be discharged under the appropriate permits.

Impacts from exploration would be similar to those discussed under alternative B.

Production

Alternative C assumes 80 percent of the volume of CBNG water produced would be discharged directly to the land surface adjacent to the wellhead. Impacts to water resources would consist of those effects of coal seam drawdown described in the impacts common to all alternatives section, soil erosion and the increase in suspended sediments in area rivers and streams, changes in the elevation of groundwater in alluvial aquifers, changes in alluvial aquifer water chemistry and changes in the chemistry of perennial water bodies. The discharge at the CBNG wellhead would result in the erosion of soils, creating gullies that would connect to natural runoff areas where the water would join natural drainage. These natural drainages or ephemeral portions of the water-course would also be impacted by increased erosion and would likely become more nearly perennial as a result of receiving CBNG discharge water. Before the CBNG water reaches surface water, some portion would evaporate or infiltrate into the soil. The portion lost would depend upon season of the year, permeability of the soil and the presence of a shallow, unconfined aquifer connected to surface water.

In addition to direct surface discharge, produced water would also be placed into impoundments for use by livestock and wildlife. Impacts from impoundments would be similar to those described under Alternative A.

Impacts on groundwater under this alternative would be the same as in Alternative B, except that discharged water could infiltrate into soils and underlying shallow alluvial aquifers. The produced water from the only Montana CBNG field (CX Ranch) has an SAR value in excess of the water contained in most shallow aquifers, including the alluvial aquifers (ALL 2001b). If infiltration of CBNG-produced water occurred, the water quality of the alluvium could be adversely impacted.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface Water Analysis

The following discussion concentrates on watersheds of the Powder River Basin, because the Powder River Basin is the most likely area for major CBNG activity that could impact surface water resources.

Tongue River

The Tongue River could be impacted from current and future CBNG development in both the Wyoming and Montana portions of the Powder River Basin. The detailed input data, calculation of effects and a summary of impacts are presented in the SWQATR.

Table 4-41 encapsulates the effects for three stream stations along the Tongue River in Montana for Alternative C.

These results show the combined effects for CBNG water discharged from RFD development for Wyoming and Montana. These discharges would result in a 10 to 27 percent increase in surface water EC, a 211 to 725 percent increase in surface water SAR and a 5 to 28 percent increase in flow. The resultant mixed stream water can be compared to the following surface water criteria:

- Northern Cheyenne Proposed Standards: The resultant mixed water quality at the stateline station would exceed the proposed irrigation season limits for SAR during 5 months out of the year and the 7Q10; the 7Q10 flow would also exceed the EC limit. The resultant water quality is similarly above the non-irrigation season proposed limits.

- The resultant water quality at the Birney Day School station, near the southern boundary of the Reservation, would exceed the SAR limit for 11 months of the year and would only exceed the EC limit during 7Q10 flows. The water quality near the northern end of the Reservation is seen at the Ashland station. The calculated impacts at Ashland demonstrate that the Northern Cheyenne proposed standards would be exceeded for SAR on all but one month while the EC limits would not be exceeded.

TABLE 4-41
EFFECTS ON SURFACE WATERS OF THE TONGUE RIVER UNDER ALTERNATIVE C

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Tongue River at Stateline near Decker	3	100	5	1500	178	0.86	731	187	2.68-2.94	806-812
Tongue River Near Birney Day School	3	1000	5	1500	183	1.09	863	213	6.38-7.43	1055-1080
Tongue River at Brandenburg Bridge near Ashland, Montana	3	1000	5	1500	207	1.36	1016	265	9.51-11.22	1278-1319

- Ayers and Westcot: Impact analyses show that Tongue River water at Decker would not result in impacts to soil except during 7Q10 flow. The resultant water quality at the Birney Day School and Ashland stations would result in some impacts to soil during irrigation use.

- MT-Irr: These standards are set at a SAR of 3.0 and an EC of 1000 µS/cm for the Tongue River. The forecasted surface water quality under Alternative C during minimum mean monthly flows are below these standards for the Stateline station and above these standards for all other stations. As such, an authorization to degrade would be needed from the MDEQ for development to occur in this manner.

- MT-Non: These standards are set at a SAR of 5.0 and an EC of 1500 µS/cm for the Tongue River. The forecasted surface water quality under Alternative C during minimum mean monthly flows is below these standards for the Stateline station. EC values are below these standards for all stations. SAR values at the Birney Day School station and Brandenburg Bridge stations are in excess of these standards. As such, an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.

- 40 percent MMM: This analysis threshold would be 249 cfs at Decker, 256 cfs at Birney Day School and 290 cfs at Brandenburg. This analysis threshold is not exceeded at any station.

The surface water quality of the Tongue River would be degraded, requiring management practice changes by downstream users during part or all of the year under Alternative C. This is a legal option, so long as CBNG producers were granted a permit to degrade surface waters by the MDEQ. Additional impact analyses are presented in the SWQATR.

Moderate increases in flow would also result under this alternative, which may result in slight changes to physical stream conditions.

Powder River

The Powder River has its headwaters in the Wyoming portion of the Powder River Basin and as such would receive CBNG water from development in Wyoming and Montana. The detailed analysis and calculations for the data summarized in Table 4-42 can be found in the SWQATR. Table 4-42 summarizes the impacts for two stations along the Powder River for Alternative C during the minimum mean monthly flow. The analysis conducted at the Locate station includes all CBNG discharge in the Powder, Little Powder and Mizpah watersheds, cumulatively.

The Powder River contains water that is naturally above some of the proposed limits. The Powder River is expected to be affected by Wyoming and Montana CBNG development under this alternative. The resultant water quality is altered by slight changes of 1 percent to 3 percent for EC, but SAR increases by as much as 200 percent. The flow rate is expected to increase between 25 percent and 30 percent. The resultant mixed stream water and CBNG water can be compared to the following surface water criteria:

TABLE 4-42

EFFECTS ON SURFACE WATERS IN THE POWDER RIVER UNDER ALTERNATIVE C

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Powder River at Moorhead	5	2000	6.5	2500	145	4.65	2154	231	11.08-11.56	2226-2253
Powder River at Locate	5	2000	6.5	2500	143	4.61	2287	250	11.97-13.13	2323-2361

- Ayers and Westcot: The SWQATR displays the SAR vs. EC plots that show that the only time the water quality at the Powder River stations would be likely to cause infiltration impacts to soils under irrigation is during 7Q10 flow.

- MT-Irr: These standards are set at a SAR of 5.0 and an EC of 2,000 µS/cm for the Powder River. The forecasted surface water quality under Alternative C during minimum mean monthly flows is above the SAR and EC standards. Existing conditions also exceed this EC standard. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.

- MT-Non: These standards are set at a SAR of 6.5 and an EC of 2,500 µS/cm for the Powder River. The forecasted surface water quality under Alternative C during minimum mean monthly flows is above this SAR standard and below the EC standard. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.

- 40 percent MMM: This analysis threshold would be 203 cfs at Moorhead and 200 cfs at Locate. This analysis threshold would be exceeded at both stations.

The surface water quality in the Powder River is degraded under Alternative C. These effects would likely require management practice changes by downstream irrigators. This is a legal option, so long as CBNG producers were granted a permit to degrade surface waters by the MDEQ. Additional impact analyses are presented in the SWQATR.

Substantial increases in flow would also result under this alternative, which might result in noticeable changes to physical stream conditions.

Little Powder River

The effects to the Little Powder River station at Weston, Wyoming, would be the same as Alternative A since there are no Montana wells being discharged upstream of this station. The impacts from Montana wells downstream of this station are analyzed in the analysis for the Powder River at Locate station.

Mizpah Creek

Mizpah Creek carries water into the Powder River in Montana. There are no CBNG wells in Wyoming that could affect this watershed. Under Alternative C effects to Mizpah Creek would result from the discharge of Montana CBNG produced water only. Table 4-43 summarizes predicted changes in surface water chemistry in Mizpah Creek just upstream from its junction with the Powder River.

Although CBNG discharge would decrease surface water EC by 10 to 24 percent, the SAR would increase by 25 to 112 percent. The resultant mixed stream water can be compared to the available surface water criteria:

TABLE 4-43

EFFECTS ON SURFACE WATERS IN THE MIZPAH CREEK UNDER ALTERNATIVE C

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Mizpah Creek at Mizpah	3	500	5	500	0.26	16.6	3503	0.99	20.43-35.26	2663-3163

- Ayers and Westcot: The SWQATR displays the plots that show the mixed water quality at the Mizpah station would likely cause infiltration impacts to soils under irrigation during all flows except for one or two high flow months a year. Discharge of CBNG waters would cause further exceedance of these criteria.

- MT-Irr: These standards are set at a SAR of 3.0 and an EC of 500 µS/cm for tributaries of the Powder River. The forecasted surface water quality under Alternative C during minimum mean monthly flows is well above these standards. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.

- MT-Non: These standards are set at a SAR of 5.0 and an EC of 500 µS/cm for tributaries of the Powder River. The forecasted surface water quality under Alternative C during minimum mean monthly flows is well above these SAR and EC standards. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.

- 40 percent MMM: This analysis threshold would be 0.42 cfs. This analysis threshold would be exceeded under this alternative.

The surface water quality in Mizpah Creek is degraded under Alternative C. These effects would likely require management practice changes by downstream irrigators. This is a legal option, so long as CBNG producers were granted an authorization to degrade surface waters by the MDEQ. The Additional impact analyses are presented in the SWQATR.

Substantial increases in flow would also result under this alternative, which might result in noticeable changes to physical stream conditions.

Bighorn and Little Bighorn Rivers

These rivers carry water from the Bighorn Mountains north from Wyoming into Montana. No CBNG wells in Wyoming are expected to affect these rivers. Under Alternative C, the effects to these rivers would be the result of discharge from Montana CBNG discharge only. Table 4-44 summarizes the effects for two stations along the Little Bighorn River and one on the Bighorn River, just upstream from its confluence with the Yellowstone River, for the minimum mean monthly flow.

The resultant water quality impacts for these rivers would include an increase in EC by approximately 11 percent to 162 percent and an SAR increase of 27 percent to 400 percent. Flows would increase by 2 to 8 percent. The resultant mixed stream water can be compared to the following surface water criteria:

- Ayers and Westcot: The Technical Report displays the plots that show the mixed water quality at the Wyola and Hardin stations would be likely to cause infiltration impacts to soils under irrigation during several months of the year. The resultant water qualities represent a low EC to SAR relationship and thus the water would likely impact clayey soils if used for irrigation. Water quality at Bighorn would likely cause no infiltration impacts and be adequate to use for irrigation.

- EC and SAR standards have not been developed for these waters.

TABLE 4-44

EFFECTS ON SURFACE WATERS OF THE BIGHORN AND LITTLE BIGHORN RIVERS UNDER ALTERNATIVE C

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Little Bighorn River at Wyola	N/A	N/A	N/A	N/A	110	0.53	548	115	2.26-2.64	623-632
Little Bighorn River at Hardin	N/A	N/A	N/A	N/A	123	0.99	768	133	3.94-4.59	881-896
Bighorn River at Bighorn	N/A	N/A	N/A	N/A	1523	2.08	952	1542	2.54-2.64	968-970

- 40 percent MMM: This analysis threshold would be 154 cfs at Wyola, 172 cfs at Hardin and 2132 cfs at Bighorn. This analysis threshold is not exceeded at any station.

The surface water quality in the Bighorn rivers in Montana would be degraded, resulting in minor management practice changes by downstream users for continued irrigation use. This is a legal option, so long as CBNG producers were granted a permit to degrade surface waters by the MDEQ. Additional impact analyses are presented in the SWQATR.

Moderate increases in flow would also result under this alternative, which may result in slight changes to physical stream conditions.

Rosebud Creek

Rosebud Creek drains part of the area of the Powder River Basin in Montana. This creek begins on the Crow Reservation, flows through a portion of Montana, flows through the Northern Cheyenne Reservation, then through another portion of Montana prior to joining the Yellowstone River near Rosebud Montana. No CBNG wells in Wyoming could affect the Rosebud. The effects to this stream would be the result of CBNG discharges in Montana. Table 4-45 summarizes the predicted effects for two stations along Rosebud Creek in Montana for the minimum mean monthly flow.

These results show the effects of CBNG discharge on the flow and water quality of Rosebud Creek. Because there is so little water in the Creek naturally, flow increases by an order of magnitude with CBNG discharge and water quality is more representative of the CBNG discharged water than the existing stream water quality. The resultant mixed stream water and CBNG water can be compared to the available surface water criteria:

- Ayers and Westcot: The plots show that the mixed water quality at the Kirby and Rosebud stations would likely cause severe infiltration impacts to soils under irrigation during all months of the year under Alternative C.

TABLE 4-45

EFFECTS ON SURFACE WATER OF ROSEBUD CREEK UNDER ALTERNATIVE C

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Rosebud Creek at Kirby	3	1000	5	1500	1.78	0.77	1016	22	35.62-43.25	2110-2293
Rosebud Creek at Rosebud	3	1000	5	1500	8.42	4.84	1780	49	32.85-39.32	2133-2298

- Northern Cheyenne Standards at Southern Boundary (Kirby): These standards are set a SAR of 2.0 and an EC of 1000 µS/cm. The forecasted surface water quality under Alternative C during minimum mean monthly flows would be well above these SAR and EC standards. If these standards are adopted by the EPA, CBNG operators would need to obtain authorizations to degrade from the Northern Cheyenne Tribe for development to occur in this manner.

- MT-Irr: These standards are set at a SAR of 3.0 and an EC of 1,000 µS/cm for Rosebud Creek. The forecasted surface water quality under Alternative C during minimum mean monthly flows is well above these standards at both stations. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. The non-degradation analysis threshold would also be exceeded.

- MT-Non: These standards are set at a SAR of 5.0 and an EC of 1500 µS/cm for Rosebud Creek. The forecasted surface water quality under Alternative C during minimum mean monthly flows is well above the SAR and EC standards for both stations. As such an authorization to degrade would be needed from the MDEQ for development to occur in this manner. MDEQ has never approved an authorization to degrade. The non-degradation analysis threshold criteria would also be exceeded.

- 40 percent MMM: This analysis threshold would be 2.5 cfs at Kirby and 11.8 cfs at Rosebud. This analysis threshold would be exceeded at both stations.

Under Alternative C, the surface water quality in Rosebud Creek in Montana would be degraded, resulting in severe curtailment of irrigation use of this water. This is a legal option, so long as CBNG producers were granted a permit to degrade surface waters by the MDEQ. Additional impact analyses are presented in the SWQATR.

Substantial increases in flow would also result under this alternative, which might result in noticeable changes to physical stream conditions. Increased flow may contribute to already impaired stream conditions.

Yellowstone River

The waters of the Yellowstone River are the confluence of all the other watersheds that are expected to receive effects from CBNG development in Montana. The Forsyth station would be affected by CBNG discharges into the Bighorn and Little Bighorn watersheds. The Sidney station would be affected by all Montana CBNG development and that development in Wyoming that occurs in the Tongue, Powder and Little Powder watersheds. Table 4-46 summarizes the impacts for two stations along the Yellowstone River in Montana for the minimum mean monthly flow for Alternative C.

Because of the significant volume of water available in the Yellowstone to dilute the CBNG production water in Montana and Wyoming, the resultant water quality shows only slight changes in both EC and SAR. The resultant mixed stream water and CBNG water can be compared to the following surface water criteria:

- Ayers and Westcot: The plots show that the mixed water quality would not cause infiltration impacts to soils under irrigation at any time. Under Alternative C, the surface water quality in the Yellowstone River in Montana is slightly reduced; however, there should be no management practice changes required of downstream users for continued irrigation use of this water. The resultant water quality in the Yellowstone River is sufficient for irrigation even during the months with the lowest flows.

- EC and SAR standards have not been developed for these waters.

- 40 percent MMM: This analysis threshold would be 8148 cfs at Forsyth and 8070 cfs at Sidney. This analysis threshold is not exceeded at either station.

The surface water quality in the Yellowstone River would be noticeably degraded by discharges from Montana and Wyoming under Alternative C; however, beneficial uses would not be impacted. Additional impact analyses are presented in the SWQATR.

Moderate increases in flow would also result under this alternative, which may result in slight changes to physical stream conditions.

TABLE 4-46

EFFECTS ON SURFACE WATERS OF THE YELLOWSTONE RIVER UNDER ALTERNATIVE C

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Lower Yellowstone-Sunday near Forsyth	N/A	N/A	N/A	N/A	5820	1.99	745	5850	2.18-2.22	753-754
Lower Yellowstone-Sunday near Sidney	N/A	N/A	N/A	N/A	5764	2.00	870	5857	3.12-3.31	912-917

Abandonment

Effects on water resources caused by abandonment operations would be similar to impacts by produced water discharged to the surface. The two activities—soil disturbance at abandonment and 20 years of surface discharge—would combine to increase the suspended sediment load within area surface water streams and rivers.

Crow Reservation

Effects on the Crow Reservation's surface water would be in the form of increased flow volume and changes in water quality. Groundwater impacts would be the same as Alternative B. In addition, potential CBNG development on private land within the external boundaries of the reservation could cause more direct effects that would also be similar to those effects described for the CBNG emphasis area. Surface waters would be affected in terms of both quantity and quality based on the extent of discharge to the watersheds within the reservations boundary (Bighorn, Little Bighorn, Rosebud and Squirrel Creek watersheds). The effects on these surface waters would place additional impacts onto the tribe's way of life by limiting the uses of effected waters.

Northern Cheyenne

Effects on the Northern Cheyenne Reservation are similar to effects projected for the CBNG emphasis area. Effects to surface water would include increases in flow volume and changes in various water quality parameters in the Tongue River and Rosebud Creek watersheds. The effects to the Tongue River and Rosebud Creek watersheds from Wyoming and Montana CBNG development could affect existing uses of these waters within the reservation boundary. Groundwater effects would be the similar to Alternative B, with additional impacts resulting from the infiltration of produced water into shallow aquifers along the Tongue River and Rosebud Creek watersheds within the reservation boundary.

The effects to these surface waters would limit the uses of affected waters. The changes to groundwater quality that result from infiltration would be site-specific and depend on the quality of the alluvial aquifers. The tribe can expect drawdown of coal seam aquifers from CBNG production in the area surrounding the reservation for distances of approximately four to five miles.

Conclusion

Effects on groundwater include those listed under Alternative B, as well as effects from infiltration of surface water into shallow aquifers from impoundments and drainages.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface water quality in some watersheds would be slightly to severely degraded, resulting in restricted downstream use of some waters. Surface water flows will be considerably increased in some watersheds, causing persistent riparian erosion, changes in watercourses and increased sedimentation. Surface water quality standards and non-degradation analysis thresholds for EC and SAR would be exceeded in most watersheds and beneficial uses would be impaired.

Area surface waters would be affected by an increase in suspended sediments contained in the discharged CBNG water. This increase in suspended sediment load would result from the increased erosion of soils due to surficial disturbances, CBNG water runoff from the point of discharge to drainages and from the increased erosion of stream banks resulting from increased water volume and increased SAR (which causes clays to lose their cohesiveness and erode more easily). The increase in suspended sediment content of surface water could affect its beneficial uses. All of the watersheds in the CBNG emphasis area would be vulnerable to effects from an increase in suspended sediment. Discharge to ephemeral channels would cause deepening and widening of the channels.

Effects on Montana watersheds from Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this alternative as under Alternative A.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

An estimated 20 percent of produced water would be used for beneficial uses and the remaining 80 percent would be treated to pre-development surface water chemistry prior to discharge under a MPDES permit.

Discharge would be accomplished by pipeline or constructed watercourse to the nearest body of water to eliminate soil erosion, the generation of suspended sediments and the infiltration of treated CBNG water. The treatment of CBNG-produced waters would eliminate or greatly reduce effects to surface water quality. Treatment may increase the potential for beneficial uses of CBNG water.

The changes in surface water quality shown in Table 4-47 for Alternative D are due to the discharge of untreated CBNG water from Wyoming CBNG development. Changes in flow volume are due to treated and untreated discharges in both Montana and Wyoming. The effects originating from Wyoming would be the same as those detailed under Alternative A. Effects on surface water from Montana CBNG development are due to the increases in baseflow. The stations analyzed would experience a 0.2 percent (Yellowstone at Forsyth) to 1135 percent (Rosebud at Kirby) increase in flow under this alternative. These increases in water flow rates would be likely to cause changes in streambed geometry, flow regime, stream depth distribution, presence and condition of instream vegetation and other physical factors associated with the stream and adjacent riparian zone.

Exploration

Any water generated by drilling and testing would be treated, with 80 percent of the treated water discharged via pipeline under a MPDES permit and 20 percent used for beneficial purposes. Treatment would eliminate potential impacts to water quality. Water quantity impacts would be minor because of the moderate volume produced from the testing of CBNG exploration wells.

Production

Approximately 80 percent of CBNG-produced water would be treated and discharged under this alternative. Because the water is piped to the receiving body of water, no conveyance losses are deducted.

Impoundments may be used to store CBNG water prior to treatment. Impacts from impoundments would be similar to those described under Alternative A.

Peak total field discharge during year six would add about 0.7 percent to the total discharge of the Yellowstone. In detail, every watershed, except the Yellowstone and the Bighorn, experience at least a 10 percent increase in flow in at least one portion of the watershed. Rosebud Creek, the Little Powder and Mizpah Creek would experience the greatest percentage change in baseflow during year 6, with 1,135 percent, 515 percent and 285 percent increases in baseflow respectively. These increases in flow volume would result in increased erosion in affected watersheds.

These changes in flow are in excess of the 40 percent MMM flow analysis threshold in the Rosebud and Powder River (including the Little Powder and Mizpah) watersheds. In the Rosebud watershed this exceedance would be caused by treated discharges in Montana. The exceedance in the Powder and Little Powder rivers would be due to discharges in both Montana and Wyoming. The exceedance in the Mizpah would be due to treated discharges in Montana. An increase in flow of this magnitude would likely be found to be significant under MDEQ's non-degradation rules. As such, permits to degrade would likely be needed before discharge at this scale would be allowed. Additional impact analyses are presented in the SWQATR.

TABLE 4-47

SUMMARY OF SURFACE WATER PARAMETERS BEFORE AND AFTER MIXING[1] UNTREATED CBNG DISCHARGE FROM WYOMING AND TREATED CBNG DISCHARGES FROM MONTANA UNDER ALTERNATIVE D

	Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Tongue River Stateline Near Decker	178	0.86	731	188	1.49	747
Tongue River Near Birney Day School	183	1.09	863	220	1.59	824
Tongue River at Brandenburg Bridge Near Ashland, Montana	207	1.36	1016	278	1.67	904
Little Bighorn River at Wyola	110	0.53	548	117	0.53	548
Little Bighorn River at Hardin	123	0.99	768	135	0.99	768
Bighorn River at Bighorn	1523	2.08	952	1547	2.08	952
Rosebud Creek at Kirby	1.78	0.77	1016	27[2]	0.77	1016
Rosebud Creek at Rosebud	8.42	4.84	1780	59[2]	4.84	1780
Little Powder River Stateline Station Weston, WY (No Montana CBNG wells will impact this station)	2.6	6.94	3300	16[2]	10.41	1606
Powder River at Moorhead	145	4.65	2154	233[2]	11.08	2226
Powder River at Locate	143	4.61	2287	250[2]	10.89	2268
Mizpah Creek at Mizpah	0.26	16.6	3503	1.17[2]	16.6	3503
Yellowstone at Forsyth, Montana	5820	1.99	745	5870	1.99	745
Yellowstone at Sidney, Montana	5764	2	870	5866	2.23	870

[1] Calculations of flow volume and water quality were conducted for low mean monthly stream flows and the maximum calculated levels of CBNG discharge (year 6 discharge). Change in minimum mean monthly flow is greater than 40 percent.

[2] Change in minimum mean monthly flow is greater than 40 percent.

Substantial increases in flow would also result under this alternative in some watersheds, which would result in noticeable changes to physical stream conditions.

Since discharge water would be treated, the water quality of the streams and therefore the beneficial uses of surface waters, would not be directly affected by Montana CBNG development.

The treatment of CBNG-produced waters could result in the generation of residues that would contain concentrated salts extracted from the CBNG water. This residuum would need to be analyzed on a case-by-case basis to determine its character and would need to be disposed of in an appropriate manner.

Impacts on groundwater under this alternative would be the same as in Alternative B. As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA-82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Abandonment

Effects on water resources caused by abandonment operations would be similar to the effects identified under Alternative B. When the estimated 16,500 CBNG production wells are abandoned over the 20-year life of the resource, 33,000 acres of soil would be disturbed for a short time period. This disturbed soil would be vulnerable to erosion and the resulting suspended material would be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would control soil erosion until groundcover and original site conditions are restored.

Crow Reservation Impacts

Surface water impacts on Crow Tribal Lands under Alternative D are expected to include those impacts noted in Alternative B. Because the produced water would be treated prior to discharge, the reservation could expect impacts to surface water in the form of increased flow volume to the Bighorn, Little Bighorn, Rosebud and Squirrel Creek watersheds from development on private lands within the external boundary of the reservation. Groundwater effects would be similar to those detailed in Alternative B.

Northern Cheyenne Impacts

Surface water impacts on Northern Cheyenne Tribal Lands under Alternative D are expected to include those effects noted in Alternative B with the added effects from the treated surface discharge of 80 percent of the produced water from all of the Montana CBNG wells forecast in the RFD in the Rosebud and Tongue River watersheds. Groundwater effects would include those detailed in Alternative B.

Conclusion

Treatment and discharge of produced water from Montana would not affect surface water quality, but would affect river flow volumes. Flow volumes in some watersheds would change only slightly, but some watersheds would see large flow increases, especially during times of traditionally low flow. The effects of these changes could include bank erosion, riparian area alteration and loss of indigenous habitat. Effects to surface water flow would be similar to but slightly greater than for Alternative C, due to lower conveyance loss. Effects on Montana watersheds due to Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this alternative as under Alternative A.

As discussed under Alternative A, Wyoming CBNG discharges in some watersheds will cause degradation of surface water quality and the exceedance of numerical standards. Degradation would also be caused due to severe increases in the flows of some streams. This degradation may cause beneficial uses to be impacted. As such, water management in Wyoming and Montana will likely need to be done differently than assumed under this alternative in order to protect Montana's numerical and non-degradation surface water quality standards for EC, SAR and flow. The discharge of treated CBNG water would dilute Wyoming CBNG discharges as these waters flow further into Montana. Cumulative effects on surface water could include localized erosion and stream alteration. These effects would be similar to those caused by major rain events, but they would last for the duration of the producing fields' life.

Effects from surface impoundments would be similar to effects under Alternative A.

Drawdown effects to groundwater would be the same as under Alternative B.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Water produced from CBNG wells could be managed in a much broader fashion than has been analyzed in the previous alternatives by emphasizing beneficial use of CBNG water and MPDES requirements be met. A Water Management Plan (WMP) would be required prior to exploration or production. Water management options would include injection, treatment and discharge, impoundment, direct discharge, or other operator proposed methods, provided they are addressed in the WMP, the plan is approved by the appropriate agency and MPDES requirements are met. The WMP must address both site-specific conditions and cumulative effects of proposed water management methods. The plan would address the proposed water management practices and their effects on soil, water, vegetation, wildlife, stream channel stability and any other resources reasonably expected to be impacted by the actions. The WMP would be submitted in conjunction with Plans of Development (PODs) and would need to be approved prior to or concurrent with the approval of any Applications for permit to Drill (APDs). Under this alternative, the Water Management Plan would be part of an Application for Permit to Drill and include certification that water well or spring mitigation agreements have been entered into with the owner(s) of any water well/spring within one mile. This is more comprehensive and thus more protective of potential impacts to existing groundwater sources. State law requires that an agreement be offered, consistent with existing State of Montana rules (MCA 82-11-175 and MBOGC Order 99-99).

Exploration

The volume of water generated by the testing of CBNG exploration wells would be stored in tanks or lined (clay or geotextile) impoundments to be disposed of under the appropriate permits.

Impacts would be similar to those discussed under Alternative B.

Production

Water would be produced by each of the 16,500 CBNG wells expected to be developed in the CBNG emphasis area. The maximum volume of CBNG water would be produced during year 6 with lesser volumes before and after this period. Unlike Alternative C, Alternative E allows for wide latitude in produced water management. The combination of emphasizing beneficial use and increased flexibility for managing produced water would likely increase water used for beneficial purposes, such as stock watering, irrigation, dust control, etc. Increases in beneficial use would also result in decreased impacts resulting from surface discharge as compared to Alternative C. Because actual management practices are yet to be defined as far as the level of beneficial use and alternate water management practices (e.g., surface discharge), Alternative E assumes 20 percent will be used beneficially.

Impacts on groundwater under this alternative would be the same as in Alternative B. As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface Water Analysis

The analyses that follow address the watersheds within the Montana portion of the Powder River Basin. Although other watersheds may be impacted around the state as a result of CBNG development, the Powder River Basin is the area most likely to experience CBNG activity. Alternative E management options would maintain the beneficial uses of existing surface water resources in the Montana portion of the Powder River Basin. These beneficial uses will be protected through the MPDES permitting process under the CWA. The Montana BER standards are a part of this process.

The impacts calculated for this alternative are based on the results from the SWQATR, with modifications resulting from the adoption of numerical standards for EC and SAR and for the definition of EC and SAR as harmful parameters. The 40 percent MMM criteria is also used in this analysis to limit flow increases in surface waters. Results are compared to surface water standards for EC and SAR were adopted by the Montana BER and EPA since the completion of the statewide document. Resultant water quality would not exceed these standards, except where existing water quality is in excess of these standards. Comparison to the standards is provided under the analysis for each watershed if appropriate.

Tongue River

The Tongue River could be impacted by current and future CBNG development in both the Wyoming and Montana portions of the Powder River Basin. The impact analysis discussed below is a summary of that analysis, using low mean monthly flows for comparison. This information for the Tongue River is summarized in Table 4-48.

Water quality before and after mixing for the Decker Station is shown graphically in Figure 4-5. In this figure water qualities before and after mixing are shown for low mean monthly flows. The resulting water qualities are plotted against the Ayers and Westcott criteria. The relationship between the resulting mixed waters can be compared to the following criteria:

- Northern Cheyenne Proposed Standards: Set at a SAR of 2.0 and an EC of 1,000 and 2,000 µS/cm at the south boundary of the Reservation. Surface water alteration forecasted under Alternative E would be below the tribe's proposed limits except during 7Q10 flow.

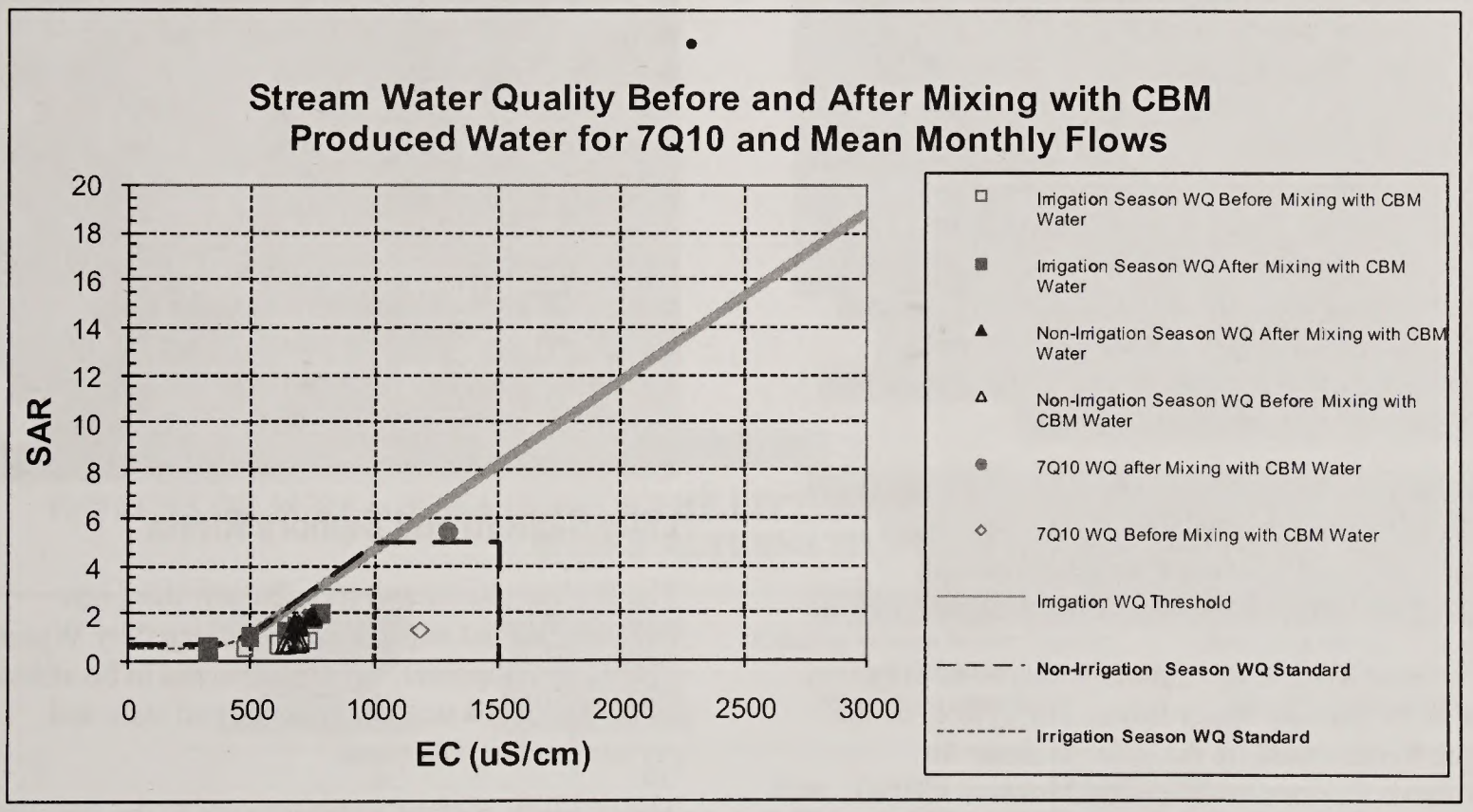
- Ayers and Westcot: The SWQATR discusses SAR versus EC plots as a way of determining potential impacts to soil texture after irrigation. The plot as shown in Figure 4-5 includes the boundary below which no impacts to soil are likely. Predicted water qualities during low mean monthly flows indicate that mixed waters will not cause infiltration impacts to soils under irrigation under Alternative E.

TABLE 4-48

EFFECTS ON SURFACE WATER FORECAST TO THE TONGUE RIVER UNDER ALTERNATIVE E

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Tongue River at Stateline Near Decker	3	1000	5	1500	178	0.86	731	183	1.93	773
Tongue River Near Birney Day School	3	1000	5	1500	183	1.09	863	190	2.52	912
Tongue River at Brandenburg Bridge Near Ashland, Montana	3	1000	5	1500	207	1.36	1016	214	2.5	1058

FIGURE 4-5
WATER QUALITY PLOT BEFORE AND AFTER MIXING WITH WYOMING'S ALTERNATIVE 2A AND MONTANA'S ALTERNATIVE E CBNG DISCHARGES TONGUE RIVER NEAR DECKER, MONTANA



WQ=Water Quality

Source: Surface Water Quality Analysis Technical Report

- MDEQs Irrigation Season Standards (MT-Irr): These standards are set at a SAR of 3.0 and an EC of 1000 µS/cm for the Tongue River. The forecasted surface water quality under Alternative E during minimum mean monthly flows is below these SAR standards for all stations and below these EC standards for all stations except for the station at Brandenburg Bridge. Existing conditions at Brandenburg Bridge during minimum mean monthly flows are also in excess of this standard. The 40 percent non-degradation analysis threshold for EC (400 µS/cm) is exceeded by existing conditions and the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (1.2) is exceeded by existing conditions at the Brandenburg station and the forecasted impacts under this alternative would cause it to be exceeded at all stations.

- MDEQ Non-Irrigation Season Standards (MT-Non): These standards are set at a SAR of 5.0 and an EC of 1500 µS/cm for the Tongue River. The forecasted surface water quality under Alternative A during minimum mean monthly flows is below these SAR and EC standards for all stations. The 40 percent non-degradation analysis threshold for EC (600 µS/cm) is exceeded by existing conditions and the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (2) is not exceeded by existing conditions at any stations; however the forecasted impacts under this alternative would cause it to be exceeded at the Birney Day School and Brandenburg stations.

- 40 percent MMM: This analysis threshold would be 249 cfs at Decker, 256 cfs at Birney Day School and 290 cfs at Brandenburg. This analysis threshold is not exceeded at any station.

The Tongue River is an important source of irrigation water in the Powder River Basin. The effects on the Tongue River would be the same as those for Alternative A, since no untreated Montana CBNG discharge to the Tongue would be assumed under this alternative analysis, besides discharge in accordance with the existing CX Ranch MPDES permit. This permit allows for 1,600 to 2,500 gpm of untreated CBNG discharge from up to 15 locations. This grandfathered permit causes some degradation of surface water quality. There would be no impact to beneficial uses under this alternative since surface water quality standards are not projected to be exceeded.

Of the 33,282 gpm predicted to be produced during year six of the RFD, approximately 31,682 gpm will need to be managed by means other than untreated surface discharge. As mentioned previously it is assumed that 20 percent of all produced water would be used for beneficial uses. Other water management options, anticipated to be used on a site-specific basis include infiltration basins, injection wells, water treatment and lined evaporation basins. These same water management practices are assumed for all watersheds analyzed. It should be noted that this distribution of water management practices is intended only for use in this analysis and is not intended to prescribe water management practices for any particular project. Any properly permitted water management alternatives can be used. A site specific Water Management Plan will need to be developed for each project under Alternative E and may include any, all, or none of the water management methods listed above.

Surface disturbance from water management activities are covered under the Assumptions section of Chapter Four. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from impoundments are discussed under Alternative A. Effects from injection facilities are discussed under Alternative B. Effects from surface discharge of treated water might include changes to stream flow, erosion and sedimentation, especially where discharge occurs to ephemeral or intermittent drainages. Hanging Woman Creek is an impaired waterbody due to siltation; surface discharge of treated water may need to be limited in this drainage.

Little Bighorn and Bighorn Rivers

The Bighorn River and its tributary, the Little Bighorn, are not expected to be affected by Wyoming CBNG development, but are expected to be affected by CBNG wells on Indian Lands and state and private lands in Montana.

The resultant surface water impacts to the Bighorn rivers would be similar to but less than Alternative C. The actual volume of water that is allowed to be discharged will depend on the water quality standards set by the Montana Board of Environmental Review and the MPDES permit program administered by the MDEQ. CBNG discharge volumes will be dependent on site-specific conditions and the approval of a WMP. In order to be approved the WMP would need to show how the produced water could be managed

without impacting beneficial uses. These results are shown in Table 4-49 and can be compared to the following surface water criteria:

- Ayers and Westcot: Predicted water qualities would only exceed this criterion during 7Q10 flows and only at the upstream stations under this alternative.

- EC and SAR standards have not been developed for these waters.

- 40 percent MMM: This analysis threshold would be 154 cfs at Wyola, 172 cfs at Hardin and 2132 cfs at Bighorn. This analysis threshold is not exceeded at any station.

Surface water would be degraded under this alternative; however there would not be anticipated impacts to beneficial uses since standards would not be exceeded. Additional impact analyses are presented in the SWQATR.

The water management in the Bighorn Watershed is assumed to be similar to the Tongue; however since discharges would be under the National Pollutant Discharge Elimination System (NPDES) program, some untreated discharge could occur. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from impoundments are discussed under Alternative A. Effects from injection facilities are discussed under Alternative B. Effects from surface discharge of treated water might include changes to stream flow, erosion and sedimentation, especially where discharge occurs to ephemeral or intermittent drainages.

Rosebud Creek

Rosebud Creek is not expected to be affected by Wyoming CBNG wells and because Rosebud Creek contains such high quality water at such low flow rates, there is expected to be no discharge of Montana CBNG water into Rosebud Creek under the analysis of Alternative E. For comparison purposes, these forecasted effects are summarized on Table 4-50.

The effects on Rosebud Creek would be the same as those for Alternative A, since no additional Montana discharges to Rosebud Creek are assumed under this alternative. A comparison to surface water quality criteria is provided in the discussion of Rosebud Creek under Alternative A. As there would be no discharge under this alternative there would be no degradation of beneficial uses.

The water management in the Rosebud Watershed is assumed to be similar to that in the Tongue; however no treated or untreated discharges would occur. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from impoundments are discussed under Alternative A. Effects from injection facilities are discussed under Alternative B.

TABLE 4-49

EFFECTS ON SURFACE WATERS OF THE LITTLE BIGHORN AND BIGHORN RIVERS UNDER ALTERNATIVE E

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Little Bighorn River at Wyola	N/A	N/A	N/A	N/A	110	0.53	548	115	2.26 – 2.64	623-632
Little Bighorn River at Hardin	N/A	N/A	N/A	N/A	123	0.99	768	133	3.94-4.59	881-896
Bighorn River at Bighorn	N/A	N/A	N/A	N/A	1523	2.08	952	1542	2.54-2.64	968-970

TABLE 4-50

EFFECTS ON SURFACE WATER IN THE ROSEBUD CREEK UNDER ALTERNATIVE E

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Rosebud Creek at Kirby	3	1000	5	1500	1.78	0.77	1016	1.78	0.77	1016
Rosebud Creek at Rosebud	3	1000	5	1500	8.42	4.84	1780	8.42	4.84	1780

Little Powder River

The effects on the Little Powder River surface water quality at the Weston, Wyoming, station would be the same as Alternative A, since there are no Montana wells discharging upstream of this station. The effects from Montana wells downstream of this station are calculated in the analysis for the Powder River at Locate station.

The water management in the Little Powder Watershed is assumed to be similar to that in the Tongue. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. Effects from impoundments are discussed under Alternative A. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from injection facilities are discussed under Alternative B. Effects from surface discharge of treated water might include changes to stream flow, erosion and sedimentation, especially where discharge occurs to ephemeral or intermittent drainages.

Powder River

The impacts to the Powder River watershed are shown in Table 4-51; impacts to EC, SAR and flow will come from discharges to the river from Wyoming CBNG development As the increase in flow which result from Wyoming CBNG development are projected to exceed the 40%MMM analysis threshold, it is not anticipated that any discharge of treated or untreated CBNG water will be allowed in Montana. These resulting surface water qualities can be compared to the following surface water criteria:

- Ayers and Westcot: This criterion would only be exceeded during 7Q10 flows under this alternative
- MT-Irr: These standards are set at a SAR of 5.0 and an EC of 2,000 µS/cm for the Powder River. The forecasted surface water quality under Alternative E during minimum mean monthly flows would be above the SAR and EC standards. Existing conditions also exceed this EC standard. An authorization to degrade would be needed from the MDEQ for development to occur in this manner. As such, it is anticipated the adopted SAR standard will severely curtail untreated CBNG discharges in the Powder River watershed. In Montana MPDES permits are required and these permits would need to incorporate the Montana BER standards. As such, CBNG discharges which would cause the mean monthly SAR to exceed 5.0 would not be allowed. Wyoming CBNG development may also need to proceed differently than assumed under Wyoming's Alternative 2A in order to prevent violation of the Montana BER standards at the state line. The 40 percent non-degradation analysis threshold for EC (800 µS/cm) is exceeded by existing conditions at both stations and the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (2) is exceeded by existing conditions at both stations and the resulting surface water quality would increase this exceedance.

TABLE 4-51

EFFECTS ON SURFACE WATER IN THE POWDER RIVER UNDER ALTERNATIVE E

Station	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Powder River at Moorhead	5	2000	6.5	2500	145	4.65	2154	224	10.7	2230
Powder River at Locate	5	2000	6.5	2500	143	4.61	2287	236	11.36	2320

- MT-Non: These standards are set at a SAR of 6.5 and an EC of 2,500 µS/cm for the Powder River. The forecasted surface water quality under Alternative E during minimum mean monthly flows is above this SAR standard and below the EC standard. An authorization to degrade would be needed from the MDEQ for development to occur in this manner. MDEQ has never approved an authorization to degrade. As such, it is anticipated the adopted SAR standard will severely curtail untreated CBNG discharges in the Powder River watershed. In Montana MPDES permits are required and these permits would need to incorporate the Montana BER standards. As such, CBNG discharges which would cause the mean monthly SAR to exceed 6.5 would not be allowed. Wyoming CBNG development may also need to proceed differently than assumed under Wyoming's Alternative 2A in order to prevent violation of the Montana BER standards at the state line. The 40 percent non-degradation analysis threshold for EC (1000 µS/cm) is exceeded by existing conditions at both stations and the resulting surface water quality would increase this exceedance. The 40 percent non-degradation analysis threshold for SAR (2.6) is exceeded by existing conditions at both stations and the resulting surface water quality would increase this exceedance.

- 40 percent MMM: This analysis threshold would be 203 cfs at Moorhead and 200 cfs at Locate. This analysis threshold would be exceeded at both stations.

The Powder River watershed is unique to the PRB in Montana; the existing water is seasonally variable and often of low quality, there is significant CBNG discharge to this river in Wyoming at the present time that does not appear to be impacting the river [see Appendix E in the SWQATR Greystone 2002)] and CBNG water quality data in the Montana portion of the watershed is limited.

CBNG producers in the Wyoming portion of this watershed will be held to the Montana BER standards at the state line since these standards have CWA standing.

There would not be anticipated impacts to beneficial uses under this alternative since MPDES permits must incorporate all applicable surface water standards. The WYDEQ has also modified its permitting process to prevent exceedance of Montana's standards at the stateline.

The water management in the Powder River Watershed is assumed to be similar to the Tongue; however no treated or untreated discharges could occur in Montana. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from impoundments are discussed under Alternative A. Effects from injection facilities are discussed under Alternative B.

Mizpah Creek

Table 4-52 illustrates the small amount of water within Mizpah Creek. Only 125 Montana CBNG wells are projected to be productive in this watershed; and there are no Wyoming CBNG wells. Impacts are expected to be similar under Alternative E as under Alternative A, since only CBNG water which had been treated to ambient water quality could be discharged. Beneficial uses would not be reduced.

The water management in the Mizpah Creek Watershed is assumed to be similar to the Tongue. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. Effects from impoundments are discussed under Alternative A. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from injection facilities are discussed under Alternative B. Effects from surface discharge of treated water may have noticeable effects on stream flow, erosion and sedimentation in this watershed, especially where discharge occurs to ephemeral or intermittent drainages.

Yellowstone River

The Yellowstone River receives the combined flows of all the other watersheds in the Montana portion of the Powder River Basin. The Forsyth station is the upstream station which receives no contribution from Wyoming discharges, but will receive some Montana CBNG discharge. The Sidney station is the downstream station and it will receive discharges from all Montana Powder River Basin wells and approximately 21,391 CBNG wells from the Wyoming portion of the Powder River Basin under Alternative E.

The effects to the Yellowstone River would be less than those indicated for Alternative C as the volume of CBNG water discharged to tributaries of the Yellowstone would be limited. Table 4-53 summarizes the effects of these discharges on the Yellowstone River. These resultant surface water chemistries can be compared to the following criteria.

- Ayers and Westcot: Predicted water qualities would not exceed this criterion even during 7Q10 flows.
- EC and SAR standards have not been developed for these waters.
- 40 percent MMM: This analysis threshold would be 8148 cfs at Forsyth and 8070 cfs at Sidney. This analysis threshold is not exceeded at either station.

Surface water would be slightly altered under this alternative; however there would not be anticipated impacts to beneficial uses. Additional impact analyses are presented in the SWQATR.

TABLE 4-52

EFFECTS ON SURFACE WATERS OF MIZPAH CREEK DRAINAGE UNDER ALTERNATIVE E

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC	SAR	EC	Flow	SAR	EC	Flow	SAR	EC
Mizpah Creek at Mizpah	3	500	5	500	0.26	16.6	3503	0.26	16.6	3503

TABLE 4-53

EFFECTS ON SURFACE WATER IN THE YELLOWSTONE RIVER UNDER ALTERNATIVE E

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Yellowstone at Forsyth, Montana	N/A	N/A	N/A	N/A	5820	1.99	745	5851	2.22 – 2.18	753 – 754
Yellowstone at Sidney, Montana	N/A	N/A	N/A	N/A	5764	2	870	5848	2.54 – 2.60	891 – 893

The water management in the Yellowstone River Watershed as a whole is assumed to be similar to the Tongue. Surface disturbance from water management activities are covered under the Assumptions section of Chapter 4. Effects from impoundments are discussed under Alternative A. These ground disturbing activities would result in slight short term increases in sediment yield and suspended sediment loads until vegetation becomes reestablished. Effects from injection facilities are discussed under Alternative B. Effects from surface discharge of treated water might include changes to stream flow, erosion and sedimentation, especially where discharge occurs to ephemeral or intermittent drainages.

Summary of Surface Water Impacts

A summary of calculated surface water effects by USGS station for Alternative E is shown in Table 4-54. The table summarizes effects of forecast discharges of CBNG water from the Wyoming Alternative 2A and Montana's Alternative E for watersheds in the Montana portion of the Powder River Basin. Surface water quality in some watersheds would be slightly degraded; however, downstream uses would not be diminished. Surface water flow would be moderately increased causing some riparian erosion, as well as increased sedimentation. In some watersheds these increases in flow would be in excess of the 40 percent MMM analysis threshold.

TABLE 4-54

CUMULATIVE IMPACTS ON SURFACE WATERS UNDER WYOMING'S ALTERNATIVE 2A AND MONTANA'S ALTERNATIVE E

	MDEQ Surface Water Quality Standards Irrigation Season		MDEQ Surface Water Quality Standards Non-Irrigation Season		Existing Stream Water Quality and Quantity (Min. Mean Monthly)			Resulting Stream Water Quality and Quantity (Min. Mean Monthly)		
Station	SAR	EC (µS/cm)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)	Flow (cfs)	SAR	EC (µS/cm)
Tongue River at Stateline Near Decker	3	1000	5	1500	178	0.86	731	183	1.93	773
Tongue River Near Birney Day School	3	1000	5	1500	183	1.09	863	190	2.52	912
Tongue River at Brandenburg Bridge Near Ashland, Mt.	3	1000	5	1500	207	1.36	1016	214	2.5	1058
Little Bighorn River at Wyola	N/A	N/A	N/A	N/A	110	0.53	548	115	2.26 – 2.64	623 - 632
Little Bighorn River at Hardin	N/A	N/A	N/A	N/A	123	0.99	768	133	3.94-4.59	881-896
Bighorn River at Bighorn	N/A	N/A	N/A	N/A	1523	2.08	952	1542	2.54-2.64	968-970
Rosebud Creek at Kirby	3	1000	5	1500	1.78	0.77	1016	1.78	0.77	1016
Rosebud Creek at Rosebud	3	1000	5	1500	8.42	4.84	1780	8.42	4.84	1780
Little Powder River Stateline Weston,	5	2000	6.5	2500	2.6	6.94	3300	16	10.41	1606
Powder River at Moorhead	5	2000	6.5	2500	145	4.65	2154	224	10.7	2230
Powder River at Locate	5	2000	6.5	2500	143	4.61	2287	236	11.36	2320
Mizpah Creek at Mizpah	3	500	5	500	0.26	16.6	3503	0.26	16.6	3503
Yellowstone at Forsyth, Montana	N/A	N/A	N/A	N/A	5820	1.99	745	5851	2.18 – 2.22	753 – 754
Yellowstone at Sidney, Montana	N/A	N/A	N/A	N/A	5764	2	870	5848	2.54 – 2.60	891 - 893

The adoption of the Montana BER numerical standards since completion of the Statewide document and the non-degradation rules will reduce impacts to surface water quality from CBNG, particularly in the Powder River watershed. These standards are not anticipated to be exceeded, except where existing conditions exceed these standards. As such, beneficial uses of surface waters will not be impacted.

Abandonment

Impacts to water resources due to abandonment operations would be similar to impacts under Alternative B. When the estimated 16,500 CBNG production wells are abandoned over the 20-year project life, 33,000 acres of soil would be disturbed and reclaimed. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would reduce soil erosion until groundcover and original conditions are restored.

Crow Reservation

Surface water effects on tribal lands under Alternative E would be similar to, but less than, those effects noted in Alternative C. The wider variety of water management options would lessen the effects from produced water. Groundwater effects within the reservation boundary would be identified and controlled by monitoring and production restrictions. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases would be restricted.

Northern Cheyenne

Surface water effects to Northern Cheyenne Tribal Lands under Alternative E would be similar to those impacts noted in Alternative A, since no additional direct discharge of CBNG water is assumed to occur in the Tongue River or Rosebud Creek. The beneficial use of the Tongue and Rosebud streams would be maintained under Alternative E.

CBNG developments have the potential to impact groundwater resources under tribal lands. Groundwater impacts within the reservation boundary would be detected and managed by monitoring the magnitude of aquifer drawdown. The monitoring wells would be engineered and placed to best intercept drawdown effects from CBNG development. Nests of monitoring wells will be used to track drawdown of multiple producing coal seams. The USGS has installed six well clusters along the southern boundary of the reservation. The BLM has also installed monitoring well clusters throughout the Montana portion of the Powder River Basin, including areas adjacent to the Northern Cheyenne and Crow reservations. The BLM wells will provide regional hydrological information as well as locally important data. In addition, CBNG operators are required to monitor groundwater levels within CBNG fields. The entire monitoring well network would monitor drawdown of coal seams and surface aquifers. Monitoring well data would be placed in the public record by the USGS, the BLM and responsible state agencies where it can be accessed and used by tribal officials as well as agency staff.

If drawdown is detected on the reservation, the production rate of CBNG wells operated on federal leases would be restricted until mitigation measures can be put into place. Mitigation measures could include curtailment of CBNG production, replacement of affected water wells or springs, or a hydrologic barrier engineered to reduce additional drawdown. The BLM would use all reasonable means to assure that reservation groundwater is not adversely affected by off-reservation CBNG production. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Conclusion

Effects of Alternative E to groundwater will be the same as Alternative B. Minor effects on shallow groundwater quality from impoundment infiltration and surface discharge of some untreated production water would also occur. The operator's WMPs would result in increased beneficial use of produced CBNG water, estimated to total at least 20 percent.

Cumulative impacts to Montana watersheds due Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this alternative as under Alternative A.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts. Anticipated impacts under this alternative include slight degradation of surface water quality, without diminishing downstream use.



Weathered landscape with exposed Fort Union Formation

Alternative F—Phased Development Multiple Screens (High Range)

Water produced from CBNG wells could be managed similar to that in Alternative E by emphasizing beneficial use of CBNG water while assuring MPDES as well as Phased Development requirements are met. Under this alternative statewide and watershed-wide phased development rules limit the timing of development within each watershed. Furthermore, there may be a decrease of 2,333 wells drilled if development does not occur within crucial sage-grouse habitat areas. The decrease in wells would primarily occur within the Upper Tongue watershed and to a lesser degree within the Lower Tongue and Middle Powder watersheds.

In addition to the timing factor, cumulative surface discharge of untreated CBNG water in any watershed is limited to 10 percent of the 7Q10 value. This limit would apply to intermittent and ephemeral tributaries as well as main stems. For example, the 7Q10 value for the Powder River at Locate is 1.6 cfs, so the total CBNG discharge into the Powder River watershed could be no greater than 0.16 cfs (72 gpm). Hanging Woman Creek is an intermittent stream, so its 7Q10 is zero, thus no untreated discharge from federal wells would be allowed in that drainage. For watershed totals see Table 4-55. If untreated discharge from Wyoming CBNG were greater than this limit, no untreated water would be discharged from federal CBNG wells in the Montana portion of the watershed. If pre-existing federal, state and private CBNG wells accounted for more than the untreated discharge limit, there could be no additional untreated discharge from federal CBNG wells. This analysis threshold would not be a limiting factor at this time since EC and SAR have been determined by the Montana BER to be harmful parameters which are regulated by the non-degradation rules. Since ambient water quality is greater than 40 percent of the standards in all watersheds, no untreated CBNG discharge would be allowed in Montana.

A WMP would be required prior to any exploration or production, listing the manner in which forecasted produced water would be managed. MPDES requirements must be met prior to any discharges (treated or untreated). The WMP must address both site-specific conditions and cumulative effects of proposed water management methods. The plan would address the proposed water management practices and their effects on soil, water, vegetation, wildlife, stream channel stability and any other resources reasonably expected to be impacted by the actions. The WMP would be submitted in conjunction with PODs and would need to be approved prior to or concurrent with the approval of any Applications for Permit to Drill (APDs).

TABLE 4-55

WATERSHED UNTREATED DISCHARGE LIMITS

Watershed	Most Downstream Station with Adequate Data	7Q10 (cfs)	10% of 7Q10 (cfs)	10% of 7Q10 (gpm)
Bighorn River	Bighorn near Bighorn	870	87	39,046
Rosebud Creek	Rosebud near Rosebud	0	0	0
Tongue River	Tongue River at Brandenburg Bridge	70	7	3,142
Powder River	Powder River at Locate	1.6	0.16	72

Exploration

The volume of water generated by the testing of CBNG exploration wells would be stored in tanks or lined impoundments to be disposed of under the appropriate permits.

Impacts from exploration would be similar to those discussed under Alternative B.

Production

Water would be produced by each of the 16,403 CBNG wells expected to be developed in the CBNG Planning Area. Unlike Alternatives B through E, the maximum volume of CBNG water would vary from watershed to watershed depending upon the drilling allowed by the Phased Development plan.

It is assumed that initially, drilling on state and private minerals will account for much of the CBNG drilling allowed. Because actual management practices are yet to be defined as far as the level of beneficial use and alternate water management practices (e.g., surface discharge), Alternative F, like Alternative E, assumes 20 percent will be used beneficially.

Produced water could be managed by a variety of means. Any discharges to surface waters would need to meet MPDES requirements. For this analysis it is assumed non-degradation rules for EC, SAR and flow will be applicable. The EC and SAR non-degradation rules will require all Montana CBNG discharges be treated prior to discharge. It is assumed Wyoming development will follow their Alternative 2A, except they will need to meet the numerical surface water quality standards at the stateline. Forty percent of the minimum MMM flow is used for analysis purposes to indicate where cumulative flow changes would trigger a significance determination by the MDEQ under the non-degradation rules for flow. The actual point at which this determination is made will depend on the specific information available at the time when an application is made for a MPDES permit. Water management practices other than treated discharge to surface waters include beneficial use, injection, impoundment and any other properly permitted water management practice.

Impacts from impoundments would be similar to those described under Alternative A; however the amount of surface disturbances would be commensurate with the increased number of potential impoundments similar to Alternative E.

Because of the conditions for development within the crucial sage-grouse habitat areas, a lower level of development is anticipated to occur over approximately 93,529 acres of which 78,982 acres are in the Upper Tongue watershed, 11,820 acres are in the Lower Tongue watershed and 2,727 acres are in the Middle Powder watershed. This would represent a decrease of 1970 wells drilled in the Upper Tongue watershed, 295 wells in the Lower Tongue watershed and 68 wells in the Middle Powder watershed. If development does not occur within the crucial sage-grouse habitat then the quantity of CBNG produced water would be decreased in proportion to the number of fewer wells drilled for the three watersheds which contain crucial sage-grouse habitat. Additionally, if development does not occur within the crucial sage-grouse habitat areas then the drawdown of groundwater would be locally lessened around these areas.

Impacts on groundwater under this alternative would be the same as in Alternative B. As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175

and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface Water Analysis

The analyses that follow address the watersheds within the Montana portion of the Powder River Basin. Although other watersheds may be impacted around the state as a result of CBNG development, the Powder River Basin is the area most likely to experience CBNG activity. The Alternative F management option would maintain the beneficial uses of existing surface water resources in the Montana portion of the Powder River Basin. The number of APDs listed for each watershed is in Table 4-1. Under this alternative the MDEQ's non-degradation analysis thresholds for EC, SAR and Flow would apply to discharges in Montana while Wyoming development would operate under their Alternative 2A. The 10 percent of 7Q10 untreated discharge threshold is maintained for this alternative; however it would not be an issue unless either EC or SAR were determined to be non-harmful parameters since new untreated discharges would not be allowed in Montana due to non-degradation standards. Therefore the 10 percent of 7Q10 untreated discharge threshold is not a part of this analysis, but rather provides an additional level of assurance due to the transitional nature of CBNG rules in Montana at this time. Treated discharges will be held to ambient water quality.

For analysis purposes it is assumed that for this alternative 20 percent of the produced water will be used beneficially and the rest will be treated and discharged unless MPDES permits are limited due to the MDEQ's cumulative non-degradation standard for flow (assumed in this analysis to be encountered at 40 percent MMM). If the flow limit is encountered, the remaining CBNG water would be managed by other options, which this analysis assumed to be split as 40 percent evaporation basins, 30 percent infiltration basins and 30 percent injection. This split is for analysis purposes only and is in no way intended to limit properly permitted water management options.

Tongue River

The Tongue River could be impacted by current and future CBNG development in both the Wyoming and Montana portions of the Powder River Basin. The peak rate of water production from Montana CBNG wells in the Tongue River watershed under Alternative F would occur in year 7 when 29,832 gpm would be produced. Twenty percent of this produced water (5,966 gpm) is assumed to be used for beneficial uses.

Conditions placed on the development of CBNG within crucial sage-grouse habitat may result in less CBNG water being produced and potentially being discharged to the Tongue River. There are 78,982 acres of crucial sage-grouse habitat within the Upper Tongue River watershed and 11,820 acres within the Lower Tongue watershed.

Impacts from water management activities will be similar to E. No additional untreated Montana CBNG surface discharge to the Tongue would be assumed under this alternative. One existing permit allows for 1,600 to 2,500 gpm of untreated CBNG discharge from up to 15 locations. Therefore, the surface water quality impacts will be similar to those listed under Alternative E.

The Tongue River is an important source of irrigation water in the Powder River Basin. The existing permits are anticipated to cause an unnoticeable amount of alteration in water quality and there would not be anticipated impacts to beneficial uses under this alternative since standards would not be exceeded. Any future MPDES permits for untreated discharge would require an authorization to degrade.

Little Bighorn and Bighorn Rivers

The Bighorn River and its tributary, the Little Bighorn, are not expected to be affected by Wyoming CBNG development, but are expected to be affected by CBNG wells on state, private and federal lands in Montana.

The resultant surface water quality impacts to the Bighorn rivers would be between those identified for Alternatives D and E since untreated discharge is anticipated under the Preferred Alternative only on the Crow Reservation. Untreated discharges could occur on the Crow Reservation, provided appropriate NPDES permits were obtained from the EPA. The EPA has not developed standards for EC or SAR and Montana's "harmful" designation for these parameters has not been approved by the EPA, leaving it unenforceable upstream onto the Crow Reservation. NPDES permits issued by EPA would need to meet Montana's numerical standards for EC and SAR (which have been approved under the CWA) at the reservation boundary. The expected discharges would be much less than the 40 percent MMM analysis threshold. The disturbance associated with these water management activities would be comparable to that estimated under Alternative E.

Actual CBNG discharge volumes will be dependent on site-specific conditions and the approval of a

WMP. In order to be approved the WMP would need to show how the produced water could be managed without impacting beneficial uses. MPDES/NPDES permits will be required prior to the approval of WMPs. As such, there would be no impact to beneficial uses under this alternative.

The slight increases in flow which would result from treated discharges may result in slight changes to physical stream conditions.

Rosebud Creek

Rosebud Creek is not expected to be affected by Wyoming CBNG wells and because Rosebud Creek contains such high quality water at such low flow rates, there is expected to be no untreated discharge of Montana CBNG water into Roscbud Creek under the analysis of Alternative F. Limited discharge of treated water could occur but the 40 percent MMM analysis threshold is the limiting factor. As there would be no untreated discharge under this alternative, the resulting water quality would be the same as Alternative D and there would be no degradation of beneficial uses. Other management practices such as injection, infiltration, beneficial use and evaporation will also need to be utilized.

The moderate increases in flow which would result from treated discharges may result in slight changes to physical stream conditions.

Little Powder River

The Little Powder watershed is the site of CBNG development in Wyoming but the most prospective portion of the Fort Union Formation (the Tongue River Mcmber) is sparsely present under this watershed in Montana. Becausc of the distribution of the Fort Union, little CBNG exploration and production is expected to occur in the Montana portion of the watershed. The quality of the Little Powder River exceeds the numerical standards of the MDEQ and it is an intermittent stream (7Q10=0). Therefore, no untreated discharges are expected under Alternative F. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be comparable to that estimated under Alternative E. Impacts would be the same as Alternative A and there would be no degradation of beneficial uses.

The slight increases in flow which would result from treated discharges may result in minor changes to physical stream conditions.

Powder River

Alternative F assumes 100 percent of potential CBNG discharge (40 percent MMM) would be taken up by Wyoming development, therefore none of the water produced in Montana would be discharged under this alternative. The impacts to surface water quality undcr Alternative F will be similar to those identified for Alternative D, except discharges would be limited by the 40 percent MMM analysis threshold. Other management practices such as injection, infiltration, beneficial usc and evaporation will need to be utilized. The disturbance associated with these water management activities would be comparable to that estimated under Alternative E.

Conditions placed on the development of CBNG within crucial sage-grouse habitat may result in less CBNG water being produced and potentially being discharged to the Powder River. There are 2,727 acres of crucial sage-grouse habitat within the Middle Powder River watershed.

Mizpah Creek

Impacts to surface waters are expected to be similar to Alternative A since no untreated CBNG produced water could be discharged under this alternative and treated discharges would be limited by the 40 percent MMM analysis threshold. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be comparable to that estimated under Alternative E. Beneficial uses would not be reduced.

The slight increases in flow which would result from treated discharges may result in minor changes to physical stream conditions.

Yellowstone River

The Yellowstone River receivcs the combined flows of all othcr watersheds in thc Montana portion of the Powder River Basin. The Forsyth, Montana station is the upstream station which receives no contribution from Wyoming discharges, but will receive some Montana CBNG discharge. The Sidney, Montana station is the downstream station and it will receive discharges from all Montana Powder River Basin wells and the approximately 21,391 CBNG wells from the Wyoming portion of the Powder River Basin under Alternative F. The cumulative impact at the Sidney station, however, is expected to be less under this alternative than undcr Alternative E. The phased development plan of this alternativc will space out the drilling and production of wells so that

the maximum development will not occur until year 12 rather than year six under Alternative E. Because development is extended out over a longer time period, the maximum development level is less under Alternative F although this peak development level will extend over more time than under Alternative E.

The Yellowstone at the Sidney gauging station will be impacted by a maximum number of wells during year 12 when Montana CBNG wells are forecast to produce 34,961 gpm of water. This is approximately 79.5 percent of the 43,989 gpm forecast for year six under Alternative E. Effects to the Yellowstone at Sidney are predicted to be slightly less than effects under Alternative E in terms of both EC and SAR, although in reality these slight differences will likely be unnoticeable. Although some discernable surface water effects may be detected at the Sidney station, beneficial uses would not be reduced under Alternative F.

Summary of Surface Water Impacts

Impacts to surface water under this alternative will be less than under Alternative E.

Surface water quality in some watersheds would be slightly degraded under Alternative F; however, downstream uses would not be diminished. Surface water flow would be moderately increased causing some localized riparian erosion, as well as locally increased sedimentation. There would not be anticipated impacts to beneficial uses under this alternative since MPDES permits would be required prior to discharge.

Abandonment

Impacts to water resources due to abandonment operations would be similar to impacts under Alternatives B through E. When the estimated 16,403 CBNG production wells are abandoned over the 20-year project life, 33,000 acres of soil would be disturbed and reclaimed. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would reduce soil erosion until groundcover and original conditions are restored.

Crow Reservation

Surface water effects on Crow Tribal Lands under Alternative F would be less than those effects noted in Alternative E. The peak volume of water discharged to the Little Bighorn River would be reduced and the water would need to be treated prior to discharge. Groundwater effects within the reservation boundary would be identified and controlled by monitoring and production restrictions. Any proposed federal CBNG development within 5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Northern Cheyenne

Surface water quality effects to Northern Cheyenne Tribal Lands under Alternative F would be similar to those impacts noted in Alternatives A and E, since no additional direct discharge of untreated CBNG water is assumed to occur into the Tongue River or Rosebud Creek. Flows in the Tongue and Rosebud would be moderately increased due to the discharge of treated water. The beneficial use of the Tongue and Rosebud streams would be maintained under Alternative F.

CBNG developments have the potential to impact groundwater resources under Northern Cheyenne Tribal Lands. Any proposed federal CBNG development within 5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists, monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Conclusion

Effects of this alternative on groundwater will be the same as Alternative B, with the exception that if CBNG development is lessened or does not occur within crucial sage-grouse habitat then groundwater drawdown would be locally decreased around these habitat areas. Additionally, modeling and monitoring would be required within 5 miles of the reservations in order to protect tribal groundwater. The operator's WMPs would result in increased beneficial use of produced CBNG water, estimated to total at least 20 percent.

Cumulative Impacts to Montana watersheds due Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this alternative as under Alternative A.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Anticipated impacts under this alternative include slight alteration of surface water quality, without diminishing downstream use. MPDES permits will be required prior to the discharge of any CBNG water (treated or untreated). The Montana BER standards are not anticipated to be exceeded and the WDEQ has modified its process to ensure numerical surface water standards are not exceeded at the stateline. As such, beneficial uses of surface waters will not be impacted.

Conditions placed on development within crucial sage-grouse habitat may result in a decreased quantity of CBNG produced water potentially being discharged; primarily to the Upper Tongue watershed and to a lesser degree the Lower Tongue and Middle Powder River watersheds.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, phased development would occur, but only 35 percent of the wells predicted for Alternative F would be drilled over the 23-year life of the resource. Maximum development is forecast to only involve 6,470 APDs and 5,823 CBNG wells. Water produced from CBNG wells could be managed similarly to that in Alternative F by emphasizing beneficial use of CBNG water while assuring that MPDES requirements are met. The distribution of wells under Alternative G is forecast by applying the 35 percent factor to each of the watersheds referred to under Alternative F.

Under Alternative G surface discharge of untreated CBNG water in any watershed is limited to 10 percent of the 7Q10 value. This limit would apply to intermittent and ephemeral tributaries as well as main stems. For watershed totals see Table 4-55. If untreated discharge from Wyoming CBNG were forecast to be greater than this limit, no untreated water would be discharged from federal CBNG wells in the Montana portion of the watershed. If pre-existing federal, state and private CBNG wells accounted for more than the untreated discharge limit, there could be no additional untreated discharge from federal CBNG wells. This analysis threshold would not be a limiting factor at this time since EC and SAR have been determined by the Montana BER to be harmful parameters which are regulated by the non-degradation rules. Since ambient water quality is greater than 40 percent of the standards in all watersheds, no untreated CBNG discharge would be allowed in Montana.

A WMP would be required prior to any exploration or production, listing the manner in which forecasted produced water would be managed. Water management options other than untreated discharge may include beneficial use, injection, or treatment and discharge or any other properly permitted water management option. MPDES requirements must be met prior to any discharges (treated or untreated). The WMP must address both site-specific conditions and cumulative effects of proposed water management methods. The plan would address the proposed water management practices and their effects on soil, water, vegetation, wildlife, stream channel stability and any other resources reasonably expected to be impacted by the actions. The WMP would be submitted in conjunction with PODs and would need to be approved prior to or concurrent with the approval of any APDs.

Exploration

The volume of water generated by the testing of CBNG exploration wells would be stored in tanks or lined impoundments to be disposed of under the appropriate permits.

Impacts from exploration would be similar to those discussed under alternative B.

Production

Water would be produced by each of the 5,853 CBNG wells expected to be developed in the

CBNG emphasis area; 35 percent of the number of wells forecast under Alternative G. Water will be managed by a number of options available to the operator. Because actual management practices are yet to be defined as far as the level of beneficial use and alternate water management practices (e.g., surface discharge), Alternative G, like Alternative F, assumes 20 percent will be used beneficially. The remainder of the water is assumed to be managed as in Alternative F discussed above except that the total volume to be managed would be only 35 percent of the volume forecast under Alternative F.

Impacts from impoundments would be similar to those described under Alternative A.

Impacts on groundwater under this alternative would be similar to Alternative B in that drawdown is anticipated to extend 4-5 miles from CBNG fields after 20 years; however there would be fewer CBNG fields that drawdown would extend from. As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface Water Analysis

The analyses that follow address the watersheds within the Montana portion of the Powder River Basin. Although other watersheds may be impacted around the state as a result of CBNG development, the Powder River Basin is the area most likely to experience CBNG activity. The Alternative G management option would maintain the beneficial uses of existing surface water resources in the Montana portion of the Powder River Basin. The number of APDs is listed for each watershed in Table 4-2. Under this alternative the MDEQ's non-degradation analysis thresholds for EC, SAR and Flow would apply to discharges in Montana, while Wyoming development would operate under their Alternative 2A. The 10 percent of 7Q10 untreated discharge threshold is maintained for this alternative; however it would not be an issue unless either EC or SAR were determined to be non-harmful parameters since new untreated discharges would not be allowed in Montana due to non-degradation standards. Therefore the 10 percent of 7Q10 untreated discharge threshold is not a part of this analysis, but rather provides an additional level of assurance due to the transitional nature of CBNG rules in Montana at this time. Treated discharges will be to ambient water quality.

For analysis purposes the same process for assuming water management practices as outlined for Alternative F would also be used under Alternative G. This split is for analysis purposes only and is in no way intended to limit properly permitted water management options.

Tongue River

The Tongue River could be impacted by current and future CBNG development in both the Wyoming and Montana portions of the Powder River Basin.

No additional untreated Montana CBNG surface discharge to the Tongue would be assumed under this alternative. One existing permit allows for 1,600 to 2,500 gpm of untreated CBNG discharge from up to 15 locations. Therefore, the surface water quality impacts will be similar to those listed under Alternative E.

The remainder of the water produced in the Tongue River watershed is assumed to be treated and discharged; however other properly permitted managed water management practices would also be allowed. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The Tongue River is an important source of irrigation water in the Powder River Basin. The existing permits are anticipated to cause an unnoticeable amount of alteration in water quality and there would not be anticipated impacts to beneficial uses under this alternative since standards would not be exceeded. Any future MPDES permits for untreated discharge would require an authorization to degrade.

Moderate increases in flow would occur as a result of treated discharges; however these increases would be less than the 40 percent MMM analysis threshold. These moderate increases in flow may result in slight changes to physical stream conditions.

Little Bighorn and Bighorn Rivers

The Bighorn River and its tributary, the Little Bighorn, are not expected to be affected by Wyoming CBNG development, but are expected to be affected by CBNG wells on Indian lands as well as federal, state and private lands in Montana. Only 35 percent of APDs and CBNG wells are expected in this watershed as under Alternative F. This volume of discharge is anticipated to only minimally affect water quality and resultant water quality would be between that calculated for Alternatives A and F. As

such there would be no degradation of beneficial uses. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The slight increases in flow that would result from this Alternative would result in unnoticeable changes to physical stream condition.

Rosebud Creek

Rosebud Creek is not expected to be affected by Wyoming CBNG wells and because Rosebud Creek contains such high quality water at such low flow rates, there is expected to be no untreated discharge of Montana CBNG water into Rosebud Creek under Alternative G; however there would be limited treated discharge. The 40 percent MMM analysis threshold would limit discharges in this watershed therefore impacts would be the same as Alternative F. The treated discharges would not degrade beneficial uses. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The moderate increases in flow caused by these discharges may result in minor changes to physical stream conditions.

Little Powder River

The Little Powder watershed is the site of CBNG development in Wyoming but the most prospective portion of the Fort Union Formation (the Tongue River Member) is sparsely present under this watershed in Montana. Because of the distribution of the Fort Union, little CBNG exploration and production is expected to occur in the Montana portion of the watershed. The quality of the Little Powder River exceeds the numerical standards of the MDEQ and it is an intermittent stream (7Q10=0). Therefore, no untreated discharges are expected under Alternative G. As such, the resultant water quality would be the same as Alternative A and there would be no degradation of beneficial uses. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The slight increases in flow which would result from treated discharges may result in minor changes to physical stream conditions.

Powder River

Alternative G assumes none of the produced CBNG water would be discharged under this alternative since the allowable discharge (40 percent MMM) would be used up in Wyoming. The impacts to surface water quality under Alternative G (from Wyoming and Montana) will be less than those forecast under Alternative A due to the development of surface water quality standards which are enforceable at the stateline. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The increases in flow which would result from Wyoming discharges may result in changes to physical stream conditions.

Mizpah Creek

Impacts to surface water quality is expected to be the same under Alternative G as under Alternative A, since no untreated CBNG produced water could be discharged; beneficial uses would not be reduced. Other management practices such as injection, infiltration, beneficial use and evaporation will need to be utilized. The disturbance associated with these water management activities would be approximately 35 percent of that estimated under Alternative E.

The slight increases in flow which would result from treated discharges may result in minor changes to physical stream conditions.

Yellowstone River

The Yellowstone River receives the combined flows of all the other watersheds in the Montana portion of the Powder River Basin. The Forsyth station is the upstream station which receives no contribution from Wyoming discharges, but will receive some MT CBNG discharge. The Sidney station is the downstream station and it will receive discharges from all 5,823 Montana Powder River Basin wells and approximately 21,391 CBNG wells from the Wyoming portion of the Powder River Basin under Alternative G. The effects to the Yellowstone River would be somewhat less than those indicated for Alternative F. Beneficial uses would not be reduced under Alternative G.

The slight increases in flow that would result from this Alternative would result in unnoticeable changes to physical stream condition.

Summary of Surface Water Impacts

Surface water quality in some watersheds would be slightly reduced; however, downstream uses would not be diminished. Surface water flow would be slightly increased, potentially causing some riparian erosion, as well as increased sedimentation. Effects would be similar to, but somewhat less than under Alternative F.

Abandonment

Impacts to water resources due to abandonment operations under Alternative G would be 35 percent of the impacts under Alternative F. When the estimated 5,823 CBNG production wells are abandoned over the 23-year resource life, an estimated 11,550 acres of soil would be disturbed and reclaimed. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless appropriate mitigating measures are employed. The implementation of various suitable mitigating measures would reduce soil erosion until groundcover and original conditions are restored.

Crow Reservation

Surface water effects on Crow Tribal Lands under Alternative G would be similar to those effects noted in Alternative F, except the peak volume of water discharged to the Little Bighorn River would be reduced. Groundwater effects within the reservation boundary would be identified and controlled by monitoring and production restrictions. Any proposed federal CBNG development within 5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists to impact tribal groundwater, monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Northern Cheyenne

Surface water quality effects to Northern Cheyenne Tribal Lands under Alternative G would be similar to those impacts noted in Alternative A, since no additional direct discharge of CBNG water is assumed to occur into the Tongue River or Rosebud Creek. The volume of flow in the Tongue and Rosebud would increase due to treated discharges. In the Tongue this increase would be less than projected under Alterative F. In the Rosebud the increase would be the same as alternative F. Slight alteration of the Tongue River would occur as a result of existing permits, however the beneficial uses of the Tongue and Rosebud would be maintained.

CBNG developments have the potential to impact groundwater resources under Northern Cheyenne Tribal Lands. Any proposed federal CBNG development within 5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists to impact tribal groundwater, monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Conclusion

Similar to the other alternatives, drawdown from CBNG developments would be expected to extend 4 to 5 miles from CBNG fields; however, there would be fewer fields to exhibit drawdown.

Cumulative Impacts to Montana watersheds due to Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this alternative as under Alternative A.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Minor effects on shallow groundwater quality from impoundment infiltration and surface discharge of some untreated production water may also occur as discussed under alternatives A and B. The operator's WMPs would result in increased beneficial use of produced CBNG water, estimated to total at least 20 percent.

Surface water effects under Alternative G would be the same as, or less than the effects of Alternative F in the individual watersheds. Even where discharge is an available option operators may choose other options when managing their CBNG water with simultaneous reductions in the volume of surface discharge. Consultation with state and federal agencies charged with managing Wyoming's resources have allowed close cooperation and improved estimation of likely impacts to the surface waters of Montana from CBNG and other activities under this alternative. The cumulative impacts to surface water and groundwater further depend upon MDEQ standards. Anticipated impacts under this alternative include slight alteration of surface water quality, without diminishing downstream use. The slight increases in flow which would result from discharges may result in minor changes to physical stream conditions.

Alternative H—Preferred Alternative - Multiple Screens

Under this alternative, CBNG development is expected in approximately the same total numbers predicted for Alternative F although development rate is somewhat different due to there being no annual or watershed limit. Water produced from CBNG wells could be managed similarly to that in Alternative F by emphasizing beneficial use of CBNG water while assuring that MPDES requirements are met. The distribution of wells under the Preferred Alternative is forecast by modifying the forecast development within the various watersheds referred to under Alternative F. In the Preferred Alternative, development of the CBNG resource under each watershed is expected to occur in a more discrete, more rapid manner rather than the drilling being drawn out within each watershed. Total wells in the watersheds and total wells in the Planning Area are forecast to be approximately the same.

If untreated discharges within a watershed exceed 10% of the 7Q10 the BLM would coordinate with MDEQ to prepare a surface water monitoring report. If the results of this analysis indicate CBNG discharges have the potential to cause exceedances of surface water quality standards, the BLM would coordinate with MDEQ to develop appropriate mitigation measures to prevent exceedances. Additionally, no future untreated discharge of CBNG water would be allowed from federal wells unless the regional surface water monitoring stations above and below the proposed discharge are active.

If CBNG discharges are causing surface water quality standards to be exceeded no additional CBNG discharges would be allowed from federal wells upstream of the exceedance. Previously approved water management plans may also be modified. Water quality thresholds and the surface water monitoring requirements are detailed in the Monitoring Appendix.

A WMP would be required prior to any exploration or production, listing the manner in which forecast produced water would be managed. Water management options other than untreated discharge may include beneficial use, injection, treatment and discharge or any other properly permitted water management option. MPDES requirements must be met prior to any discharges (treated or untreated). The WMP must address both site-specific conditions and cumulative effects of proposed water management methods. The plan would address the proposed water management practices and their effects on soil, water, vegetation, wildlife, stream channel stability and any other resources reasonably expected to be impacted by the actions. The WMP would be submitted in conjunction with PODs and would need to be approved prior to or concurrent with the approval of any APDs.

Exploration

The volume of water generated by the testing of CBNG exploration wells would be stored in tanks or lined impoundments to be disposed of under the appropriate permits.

Impacts from exploration would be similar to those discussed under alternative B.

Production

Water would be produced by each of the approximately 16,404 CBNG wells expected to be developed in the CBNG emphasis area under the Preferred Alternative. Water will be managed by a number of options available to the operator. Because actual management practices are yet to be defined as far as the level of beneficial use and alternate water management practices (e.g., surface discharge), the Preferred Alternative, like Alternative F, assumes 20 percent will be used beneficially. The remainder of the water is assumed to be managed as in Alternative F discussed above.

Impacts from impoundments would be similar to those described under Alternative A.

Impacts on groundwater under this alternative would be the same as in Alternative B with the exception that groundwater drawdown would be somewhat reduced if development does not occur or is lessened within crucial sage-grouse habitat areas. As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated the requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Surface Water Analysis

This analysis will occur following the same rules as Alternative F, except in the event the 10 percent of 7Q10 untreated discharge limit became a factor, there would be the option to wave this criterion if the monitoring identified by the IWG were in place. The analyses that follow address the watersheds within the Montana portion of the Powder River Basin. Although other watersheds may be impacted around the state as a result of CBNG development, the Powder River Basin is the area most likely to experience CBNG activity. The Preferred Alternative management option would maintain the beneficial uses of existing surface water resources in the Montana portion of the Powder River Basin.

Tongue River

The Tongue River could be impacted by current and future CBNG development in both the Wyoming and Montana portions of the Powder River Basin.

No additional untreated Montana CBNG surface discharge to the Tongue would be assumed under this alternative. One existing permit allows for 1,600 to 2,500 gpm of untreated CBNG discharge from up to 15 locations. Therefore, the surface water quality impacts will be similar to those listed under Alternative E.

The remainder of the water produced in the Tongue River watershed is assumed to be treated and discharged; however other properly permitted managed water management practices would also be allowed. The disturbance associated with these water management activities would be comparable to that estimated under Alternative E.

The Tongue River is an important source of irrigation water in the Powder River Basin. The existing permits are anticipated to cause an unnoticeable amount of alteration in water quality and there would not be anticipated impacts to beneficial uses under this alternative since standards would not be exceeded. Any future MPDES permits for untreated discharge would require an authorization to degrade. Additionally, pollutants including salinity, total dissolved solids and nutrients also are frequently associated with agricultural operations.

Moderate increases in flow would occur as a result of treated discharges; however these increases would be less than the 40 percent MMM analysis threshold. These moderate increases in flow may result in slight changes to physical stream conditions.

Little Bighorn and Bighorn Rivers

The Bighorn River and its tributary, the Little Bighorn, are not expected to be affected by Wyoming CBNG development, but are expected to be affected by CBNG wells on state, private and federal lands in Montana under the Preferred Alternative.

The resultant surface water impacts to the Bighorn rivers would be between those identified for Alternatives D and E since untreated discharge is anticipated under the Preferred Alternative only on the Crow Reservation. Actual CBNG discharge volumes will be dependent on site-specific conditions and the approval of a WMP. In order to be approved the WMP would need to show how the produced water could be managed without impacting beneficial uses. MPDES permits will be required prior to the approval of WMPs. As such, there would be no impact to beneficial uses under this alternative.

The slight increases in flow that would result from this Alternative would result in minor changes to physical stream condition.

Rosebud Creek

Rosebud Creek is not expected to be affected by Wyoming CBNG wells and because Rosebud Creek contains such high quality water at such low flow rates, there is expected to be no untreated discharge of Montana CBNG water into Rosebud Creek under the Preferred Alternative and impacts would be the same as Alternative F. As there would be no untreated discharge under this alternative there would be no alteration of beneficial uses.

The moderate increases in flow caused by these discharges may result in minor changes to physical stream conditions.

Little Powder River

The Little Powder watershed is the site of CBNG development in Wyoming but the most prospective portion of the Fort Union Formation (the Tongue River Member) is sparsely present under this watershed in Montana. Because of the distribution of the Fort Union, little CBNG exploration and production is expected to occur in the Montana portion of the watershed. The quality of the Little Powder River exceeds the numerical standards of the MDEQ and it is an intermittent stream (that is, 7Q10=0). Therefore, no treated or untreated discharges are expected under the Preferred Alternative. Impacts would be the same as Alternative F and there would be no degradation of beneficial uses.

The moderate increases in flow caused by treated discharges may result in minor changes to physical stream conditions.

Powder River

The Preferred Alternative assumes 100 percent of potential CBNG discharge (40 percent MMM) would be taken up by Wyoming development, therefore none of the water produced in Montana would be discharged either in untreated or treated form under this alternative. The impacts to surface water quality under the Preferred Alternative will the same as under Alternative F.

Mizpah Creek

Impacts to surface waters are expected to be the same under the Preferred Alternative as under Alternative F since no untreated CBNG produced water could be discharged under these alternatives and treated discharges would be limited by the 40 percent MMM analysis threshold. Beneficial uses would not be reduced.

The moderate increases in flow caused by these discharges may result in minor changes to physical stream conditions.

Yellowstone River

The Yellowstone River receives the combined flows of all other watersheds in the Montana portion of the Powder River Basin. The Forsyth station is the upstream station which receives no contribution from Wyoming discharges, but will receive some MT CBNG discharge. The Sidney station is the downstream station and it will receive discharges from all Montana Powder River Basin wells and the approximately 21,391 CBNG wells from the Wyoming portion of the Powder River Basin under the Preferred Alternative. CBNG discharges to these streams would be a combination of treated and untreated water. The cumulative impact at the Sidney station, however, is expected to be less under this alternative than under Alternative E.

The Yellowstone at the Sidney gauging station will be impacted by a maximum number of wells during year 12 when Montana CBNG wells are forecast to produce 34,961 gpm of water. Effects to the Yellowstone under the Preferred Alternative are expected to be approximately the same as those under Alternative F. Although some discernable surface water effects may be detected at the Sidney station, beneficial uses would not be reduced under the Preferred Alternative.

The slight increases in flow that would result from this Alternative would result in unnoticeable changes to physical stream condition.

Summary of Surface Water Impacts

Impacts to surface water under this alternative will be essentially the same as under Alternative F.

Surface water quality in some watersheds would be slightly altered due to existing permits and CBNG development in Wyoming; however, downstream uses would not be diminished. Surface water flow would be moderately increased causing some localized riparian erosion, as well as locally increased sedimentation.

Abandonment

Impacts to water resources due to abandonment operations would be similar to impacts under Alternative E. When the estimated 16,403 CBNG production wells are abandoned over the 20-year project life, 33,000 acres of soil would be disturbed and reclaimed. This disturbed soil would be vulnerable to erosion and the resulting suspended material could be washed into adjacent surface waters unless mitigating measures are employed. The implementation of BMPs would reduce soil erosion until groundcover and original conditions are restored.

Crow Reservation

Surface water effects on Crow Tribal Lands under the Preferred Alternative would be similar to those effects noted in Alternative F, except that the peak volume of water discharged to the Little Bighorn River would be reduced. Groundwater effects within the reservation boundary would be identified and controlled by monitoring and production restrictions. Any proposed federal CBNG development within

5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists, monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers resulting from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Northern Cheyenne

Surface water effects to Northern Cheyenne Tribal Lands under the Preferred Alternative would be similar to those impacts noted in Alternative F, since no additional direct discharge of CBNG water is assumed to occur into the Tongue River or Rosebud Creek. The beneficial use of the Tongue and Rosebud streams would be maintained under the Preferred Alternative.

CBNG developments have the potential to impact groundwater resources under Northern Cheyenne Tribal Lands. Any proposed federal CBNG development within 5 miles of the reservation boundary would be required to conduct groundwater modeling to determine if there is the potential to impact tribal groundwater. If the potential exists, monitoring of the produced coal seams will be required. The monitoring would track drawdown of aquifers from CBNG production on federal leases outside the reservation boundary. If drawdown is detected, the production rate of CBNG wells on federal leases could be restricted, or wells could be shut in, until an agreement is reached between the operator and the tribe regarding how groundwater impacts will be mitigated. Mitigation measures would substantially reduce drawdown originating from federal mineral leases, but the potential still exists for CBNG wells on nearby state and private leases to drawdown groundwater within the reservation boundaries.

Conclusion

Effects of this alternative on groundwater will be the same as Alternative B with the exception that if CBNG development is lessened or does not occur within crucial sage-grouse habitat then groundwater drawdown would be locally decreased around these habitat areas. The operator's WMPs would result in increased beneficial use of produced CBNG water, estimated to total at least 20 percent.

Cumulative impacts to Montana watersheds due Wyoming CBNG discharge, coal mines and the Tongue River Railroad would be the same under this Preferred Alternative as under Alternative A.

As discussed under impacts common to all alternatives, drawdown from CBNG could cause wells and springs which obtain their water from the developed coal seams to have reduced yields. It is anticipated requirements for water mitigation agreements under MCA 82-11-175 and the protections provided by MCA 75-15-9, will mitigate these drawdown-related impacts.

Anticipated impacts under this alternative include slight alteration of surface water quality due to existing permits in Montana as well as current and forecast Wyoming CBNG development; however downstream uses will not be diminished. MPDES permits will be required prior to the discharge of any CBNG water (treated or untreated). It is not anticipated MDEQ would allow any untreated discharges due to the non-degradation rules for EC and SAR. The Montana BER standards are not anticipated to be exceeded. As such, beneficial uses of surface waters will not be impacted.

Indian Trust and Native American Concerns

Indian Trust Assets

Indian Trust Assets (ITAs) are official interests in assets held in trust by the federal government for Indian tribes or individuals. The U.S. Department of the Interior (DOI) Departmental Manual 303 DM 2 defines ITAs as lands, natural resources, money, or other assets held by the federal government in trust or that are restricted against alienation for Indian tribes and individual Indians.

Alternative A
No Action (Existing CBNG Management)

- No measurable impacts to Indian trust impacts would occur from the CBNG activities.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Federal:
  - No surface water quality impacts.
  - Potential CBNG drainage, dependent on specific site conditions, delayed by buffer zone.
  - Air Quality impacts to reservation PSD Class I areas.
  - Visibility impacts.
  - Potential cultural resource impacts to TCPs
- State:
  - Groundwater drawdown inward from reservation boundaries.
  - Potential CBNG drainage, dependent on specific site conditions, no delay due to adjacent development.

Alternative C
Emphasize CBNG Development

- Federal:
  - Potential for surface water quality and quantity impacts.
  - Potential CBNG drainage, same as Alternative B.
  - Cultural Resource impacts same as B.
  - Air quality and visibility impacts same as Alternative B.
- State:
  - Groundwater drawdown same as Alternative B.
  - Surface water quality and quantity impacts.
  - Potential CBNG drainage, same as Alternative B.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Federal:
  - Groundwater drawdown same as Alternative B.
  - Surface water quality impacts reduced by source treatment, increased availability of surface waters for irrigation and other beneficial uses
  - Increased surface water flow could in increase riparian erosion.
  - Potential CBNG drainage, same as Alternative B.
  - Cultural Resource impacts same as B.
  - Air Quality and visibility impacts reduced.
- State:
  - Groundwater drawdown same as Alternative B.
  - Surface water quality impacts reduced.
  - Potential CBNG drainage, same as Alternative B.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Federal:
  - Effects from groundwater drawdown substantially reduced by resource protection protocols. Potential CBNG drainage mitigated or compensated.
  - Surface water quality impacts reduced, with increased availability of surface waters for irrigation and other beneficial uses.
  - Increased surface water flow could increase riparian erosion.
  - Air Quality impacts mitigated through site specific permits and control measures.
- State:
  - Groundwater drawdown potential on the reservations would be minimized. CBNG drainage minimized by state spacing.
  - Surface water quality protected.

Alternative F
Phased Development Multiple Screens (High Range)

- Federal:
  - Potential effects from groundwater drawdown reduced by implementation of a 5-miles buffer zone. Potential CBNG drainage mitigated or eliminated.
  - Surface water quality impacts reduced.
  - Traditional cultural property (TCP) sites identified sooner through the use of block surveys and tribal consultations.
  - Air Quality impacts mitigated through site specific permits and control measures.
- State:
  - Same as Alternative E

Alternative G
Phased Development Multiple Screens (Low Range)

- Federal:
  - Potential impacts from alternative G would be similar to Alternative F except that they would be approximately 65 percent less due to the reduced number of APDs that are predicted to be issued. A 5-mile buffer zone would still be implemented around the reservation boundaries to protect against CBNG drainage or groundwater drawdown
  - Surface water quality impacts similar to Alternative F although reduced due to the decreased number of APDs that are predicted to be issued.
  - TCP site identified sooner through the use of block surveys and tribal consultations.
  - Air Quality impacts mitigated through site specific permits and control measures.
- State:

Same as Alternatives E and F.

Alternative H Preferred Alternative - Multiple Screens
• Federal: – Potential effects from groundwater drawdown reduced by implementation of a 5-miles buffer zone. Potential CBNG drainage mitigated or eliminated. – Surface water quality impacts reduced. – TCP site identified sooner through the use of block surveys and tribal consultations. – Air Quality impacts mitigated through site specific permits and control measures. • State: – Groundwater drawdown potential on the reservations would be minimized. CBNG drainage minimized by state spacing. Surface water quality protected.

Assumptions

The BLM's responsibilities include identifying and protecting tribal resources and trust assets from impacts resulting from BLM actions. The state does not have a trust responsibility similar to the federal governments. The 2-mile buffer zone around the reservations as called for in the management objectives for Alternatives B and D would only apply to federal leases. The 5-mile buffer zone around the reservations as called for in the management objectives for Alternatives F, G and H would only apply to federal leases.

Impacts From Management Common to All Alternatives

While the BLM would not have jurisdiction over Indian lands located on or off the reservation, the BLM would have a trust responsibility that encompasses oil and gas exploration. Indian Trust Assets (ITAs) would be managed following the DOI Secretarial Order 3215, Principles for the Discharge of the Secretary's Trust Responsibility.

The conventional wells expected to be drilled on BLM-administered lands could impact adjacent reservation lands by draining tribal hydrocarbons or groundwater, or even by allowing produced water to impact surface water resources or soil. Drainage by adjacent wells is addressed by 43 CFR Part 3162.2-2, which instructs the BLM on steps to be taken to protect Indian landowners from drainage.

The number of conventional wells estimated for reservation development (12) coupled with the predicted wells (less than 25) adjacent to reservation lands; do not represent a measurable increase in development on or near the reservation for the next 20 years. This level of development would not impact tribal hydrocarbons or effect groundwater resources. The direct land impacts from this small number of wells on reservation lands would be minor (less than 75 total acres impacted) with regard to grazing lands, vegetation and biological resources.

Construction and maintenance of the Tongue River Railroad (TRR) route would not directly impact Indian reservation lands; however, emissions from trains could impact air quality over parts of the reservations. Because of the proximity of the approved TRR route, the two reservations and residents could be indirectly impacted by the construction activities and the train traffic. Impacts to Indian lands along the entire TRR extension route are described, in part, in the follow three reports:

- Potential Cultural Effects on the Northern Cheyenne from the TRR Extension (Deaver and Tallbull 1991)
- Montana Department of Natural Resources Conservation, Tongue River Reservoir EIS (Aaberg and Tallbull 1993, Peterson et al. 1995)
- Draft Economic, Social, Cultural Supplement, Powder River I Regional EIS, (BLM 1989)
- TRR EIS (Surface Transportation Board 2004)

In considering Native American concerns, any Surface Transportation Board decision during construction or operation of the TRR Extension would be subject to the mitigation set forth in the programmatic agreement as detailed in Chapter 4.2.5.3 of the Supplemental EIS for the TRR Extension (STB 2004).

Social and economic impacts identified by the Northern Cheyenne that are associated with the construction of the TRR center primarily on potential in-migration of Native and non-Native Americans in search of construction related jobs. If the regional population was to increase, there are fears that non-Native Americans would settle in reservation communities if off-reservation housing facilities prove inadequate, leading to potential commensurate increase of contact with non-Native Americans. This increased inter-racial contact could increase tribal member exposure to prejudice; intolerance; and divergent ideas, values and behaviors (ICC 1992).

With regards to important wild plants, there are concerns that traditional gathering localities may be disturbed and access to these areas could be precluded by fencing erected along the route (ICC 1992).

As discussed earlier under Alternative C, the Absaloka Coal Mine could be encroached on by CBNG development but wells could not be drilled within permitted coal mining acres. The coal is held in trust for the Crow Tribe.

Mitigation measures would help protect Northern Cheyenne tribal resources and off-reservation sites, such as the Rosebud and Wolf Mountain Battlefields, known to be of special importance to the tribe. A discussion of these mitigation measures is presented in the Northern Cheyenne Mitigation Appendix. These mitigation and monitoring measures have been designed to help protect resources such as groundwater, CBNG, air quality, wildlife, vegetation and off-reservation cultural resources of special interest to the tribe.

The Northern Cheyenne Tribe also has off-reservation properties held in trust that consist of two, tracts of land, approximately 160 acres each, in the vicinity of the Tongue River Reservoir. The tribe also acquired off-reservation surface estate consisting of the Moreland Ranch property. The mineral estate for the Moreland Ranch property is owned by the Consolidated Coal Company and could be subject to development; however it is currently not leased. The BLM would consult with the tribe to determine what mitigation measures are needed to protect the surface use of the ranch. Tribal buffalo herds are pastured at the Moreland Ranch property.

With regard to off-reservation TCPs and cultural artifacts the BLM has implemented a cultural survey requirement for the majority of CBNG lands to be developed under each POD. The use of these "block surveys" coupled with tribal consultation requirements has demonstrated the ability to identify the majority of sites that could be affected and reduce the potential impacts associated with developing CBNG in the vicinity of cultural resources.

Furthermore, on January 12, 2006, the BLM Montana State Office issued additional cultural resource requirements for oil and gas operations in Montana and the Dakotas. These requirements are intended for both oil and gas operators and cultural resource consultants hired by oil and gas operators. They supplement the *Guidelines for Identifying Cultural Resources H-8110-1* (the handbook) which remains the basic guidance for cultural resource work completed for BLM undertakings. Notice to Lessees, NTL-MSO-1-85, provides guidelines to operators when they are required to conduct cultural resource inventories. The NTL establishes the minimum survey area of 10 acres centered on each proposed well plus the access road, pipeline and ancillary areas subject to surface disturbance. Washington Office Instruction Memorandum (IM) No. 2003-147 (BLM 2003c) recommends block surveys ranging from 40 acres for individual wells to entire lease or full field development areas for large-scale projects to improve the APD process. Block surveys offer many advantages including reducing the probability that multiple surveys will be required to site a single project. Additionally, operators are encouraged to complete cultural resource surveys prior to the onsite inspection. This will allow the well location and/or access route to be sited prior to the onsite in order to avoid adverse effects on cultural resources and reduce the likelihood of having to change a location due to a cultural resource conflict discovered later in the APD review process.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

There would not be any impacts to measurable ITAs from the CBNG activities planned under this alternative.

This is based on the limited development scenario under this alternative, the known locations of production wells (CX Ranch) and the number of exploration wells.

Conclusion

There would not be any impacts to ITAs from management decisions under Alternative A or from management practices common to all alternatives. Cumulative effect impacts could result from the Absaloka Coal Mine and the production and discharge of CBNG production waters from Wyoming.

Mining activities at the 5,400-acre Absaloka Coal Mine facility located just north of the northeastern corner of the Crow Reservation has resulted in the irretrievable loss of the coal mined at approximately 5 million tons per year and has removed or disturbed approximately 3,150 acres of topsoil. Additional impacts have occurred from the dewatering of the coal that lowered the surrounding groundwater by an estimated 75 feet (Wheaton and Van Voast 1998).

Finally, the surface water within the vicinity of the mine has undergone a reduction in quality, resulting in impacts on the local watercourses and subsequent fields using these waters as sources of irrigation.

Development of CBNG in Wyoming during the next 20 years has the potential to impact the surface water, groundwater and methane resources of the Crow and Northern Cheyenne tribes. Drawdown of groundwater levels is an unavoidable impact from CBNG development. Increased groundwater drawdown would be experienced in coal seam aquifers along the southeastern border of the Crow Reservation adjacent to and up to 5 miles north of the Wyoming state line (Wheaton and Metesh 2001). The magnitude of impact to water wells and springs would depend on the location and number of CBNG producing wells south of the state boundary. Depending upon their locations, natural springs and water wells on tribal lands could go dry.

Wyoming CBNG production could also drain methane from tribal mineral resources. As groundwater is drawn down and reservoir pressures decrease, methane is liberated from the coal matrix and becomes free to be produced or migrate. Two-dimensional modeling (Crockett and Meyer 2001) suggests that drainage of methane could occur at distances more than 5 miles from a producing CBNG field. Recent three-dimensional modeling suggests that the methane drainage effect is less than two miles. This is based on the model results indicating that 80 feet of water would be drawn down at two miles from the edge of a producing field (Wheaton and Metesh 2002). In either case, the Crow Reservation is adjacent to the Wyoming boundary and is close enough to be drained by CBNG wells that may be drilled in Wyoming.

Full-scale CBNG production in the Wyoming portion of the Powder River Basin would result in limited surface discharge and infiltration of produced water to streams that flow north into Montana. Expected levels of development would result in volumes of discharged water causing a slight increase in annual flow rates of the Powder, Little Powder and Tongue rivers. A corresponding slight alteration in the quality of surface water would also be felt downstream from these Wyoming discharges. The percent increase in flow volume would be greater during periods of low-flow. This alteration may require downstream users to implement minor management changes. Impacts to the Tongue River would be felt by the Northern Cheyenne and Crow members who use river water for irrigation. Detailed discussions regarding surface water quality and flow changes are presented in the Hydrologic Resources section of this chapter.

The Bighorn and Little Bighorn rivers carry high quality water from the Bighorn Mountains north into Montana. No CBNG wells in Wyoming or Montana would impact these rivers under Alternative A. Stream water quality and flow volume would remain unchanged.

The Northern Cheyenne have a large reserved water right in the Tongue River Reservoir. That stored water represents a marketable commodity and if it were to experience even a slight decrease in quality, it would affect the tribes' ability to market or use the water. Under this full-scale Wyoming development scenario, it is conceivable that the reservoir water quality could be slightly altered.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Based on the development scenario presented in Alternative B and on the management objectives described under this alternative, potential impacts on ITAs include the drawdown of groundwater, alterations in surface water quality, air quality changes, potential social and cultural impacts, potential wildlife adaptation and the drainage of tribal CBNG.

A 20 foot drawdown of the groundwater table within the vicinity of a producing Montana CBNG field has been modeled (3D) by the Montana Bureau of Mines and Geology (MBMG) at between 4 to 5 miles from the edge of production (Wheaton and Metesh 2002). Without site-specific information, it is impossible to predict the degree of drawdown to a neighboring aquifer. In the case of the Crow and Northern Cheyenne, it is conceivable that the reservations' groundwater would be drawn down to some extent along the boundaries by both state and BLM-leased development. The drawdown of groundwater within the reservation could result in impacts on shallow stock and domestic wells and some surface springs. These impacts would reduce water pressure and in some cases could render the complete loss of water from a well or spring.

The recognition of a 2-mile buffer zone around the reservations would effectively reduce and delay the drawdown that would be experienced by the tribes in these areas from BLM leased mineral development. In the case of development on either private or state private lands, the state would not be subject to the same buffer zone restrictions and therefore, the drawdown could be generated earlier and be to a greater horizontal and vertical extent. The effect of

these combined drawdowns would create a long-term impact to the groundwater level.

The alteration of surface water quality from the management objectives in this alternative is almost negligible because the alternative calls for the injection of all produced water and the storage of all waters generated during exploration well tests. However, the potential exists for localized, short-term (less than 1 year) impacts from spills and ruptures associated with these water disposal methods. Undetected ruptures along water conduits feeding injection wells also would impact soils and create erosion problems within the immediate vicinity. These impacts are not expected to reach reservation lands under this management objective. Only the spilled or released waters entering associated watersheds near the reservations would be affected.

Numerous social and cultural impacts have been predicted by Native Americans as a result of CBNG development on adjacent private, state and federal minerals. These potential impacts include the lack of access to well-paying energy-related employment contributing to the reduced annual Native American income; over-commitment of tribal revenues; population influx; abridged effectiveness of tribal governments; stressed infrastructure and service-related capacity; altered social organization and social well-being perception; and the further influence of western culture resulting in changes to traditional belief and value systems.

Off-reservation cultural and paleontological artifacts also run the risk of being damaged or lost due to the increased access and land-disturbing activities associated with full-scale development. TCPs may be affected as development expands. These impacts would be minimized through survey and consultation with the tribes.

Wildlife would adapt to the CBNG development infrastructure in ways that could be interpreted as negative or positive. For example, depending on one's perspective, big game migratory paths could shift resulting in greater opportunities for tribal outfitters and tribal hunters or diminished chances for euro-American outfitters and hunters. This scenario could result in reduced herd strength or increased susceptibility could also be viewed as a negative outcome or singularity. Given the various and complex perspectives, wildlife impacts need to be assessed on a case-by-case basis as individual CBNG actions are reviewed.

CBNG development would threaten to drain methane resources under tribal lands in the Planning Area. Drainage of CBNG resources from Native American minerals is dependent upon local reservoir parameters. It is assumed that a single CBNG well would drain the methane from a single coal seam over an 80-acre unit. Research by the BLM in the Wyoming portion of the Powder River Basin, however, suggests that drainage may be across a broader radius (Crockett and Meyer 2001) from BLM, private, or state lands. The Wyoming BLM estimates that considerable methane drainage happens when 40 percent of the hydrostatic head is removed from the coal aquifer. Modeling by the MBMG (Wheaton and Metesh 2002) suggests that the hydrostatic head of a producing coal seam could be reduced sufficiently to cause methane liberation at a distance of approximately two miles from the edge of a producing CBNG field. The reduction of hydrostatic pressure achieved by lowering the water table within a specific coal seam is necessary for CBNG production. This reduction liberates the methane held in the coal matrix; however, the complex, site-specific aquifer conditions dictate the actual radius of methane drainage. Therefore, conclusions regarding methane drainage from tribal minerals need to be made on a case-by-case basis during development.

The reduction of the hydrostatic pressure in a coal seam and the resulting liberation of CBNG could also cause the methane to migrate along the path of least resistance and appear as an unchecked seepage at the surface. This scenario would be unlikely in view of the depths of the coal seams being explored (greater than 500 feet below the ground surface), the distance of foreseeable producing fields to the reservations and the relatively shallow groundwater wells used on the reservations for water production.

This alternative calls for the directional drilling of deeper coal seams, multiple completions in a single well bore and the simultaneous development of all coal seams within a field. These techniques would increase the likelihood that CBNG would be drawn from adjacent Indian mineral resources. Detailed explanations for these potential impacts can be found in the Hydrology, Geology and Minerals and Air Quality sections of this Chapter.

Mitigation agreements would be used to replace water lost from the drawdown of groundwater within aquifers impacted by CBNG production. These agreements would call for the replacement of the groundwater wells at the operator's expense. Another mitigation measure for large-scale groundwater drainage to the reservations is the installation of a hydraulic barrier between the production field and the reservation boundary. BLM would apply this

mitigation measure to reduce and delay any water drainage from the reservations. Although hydraulic barriers have been used successfully to prevent migration of brackish or salty waters into drinking water resources, more research would be required to determine if they could be employed successfully in the coal seam aquifers of the Powder River Basin to prevent loss of groundwater resources.

Surface water discharge permits that limit the quantity of CBNG-produced water that is discharged would mitigate the impacts from Wyoming CBNG production, as well as from expanded CX Ranch production. Potential hydrocarbon migration would be the subject of detailed monitoring and periodic drainage analysis conducted by the BLM as part of their trust responsibility (see Monitoring Appendix for details and frequency of monitoring). Monitoring and conducting drainage analysis would reduce the likelihood for drainage of tribal CBNG resources. Native American development of reservation CBNG resources is another potential mitigation measure that would ensure the tribes receive their fair share of the CBNG revenues.

Conclusion

Impacts from management decisions included in Alternative B would result in impacts to surface water quality, groundwater availability, cultural artifacts and sites, wildlife, air quality, visibility and the irreversible loss of fluid and solid minerals.

The surface water quality impacts would be similar to those described under Alternative A, with only slight alterations to current quality.

The water drawdown from Montana CBNG development under Alternative B, coupled with the development of CBNG on the reservations, would result in a more widespread effect than just adjacent to the reservation boundaries. Considering the location of known coal occurrences, the groundwater drawdown would be experienced generally along the eastern portion of the Crow Reservation and across the entire Northern Cheyenne Reservation. The water drawdown would be contingent on the continuity of the coals, many of which are fractured, crop out, pinch out or have shale stringers. Impacts could not be detailed until the fields are developed. Under any scenario of development, the BLM would take measures to mitigate reservation groundwater drawdown resulting in no contributing influences from federal mineral development.

Associated with the development of full-scale CBNG production across the Powder River Basin are a network of gas compressors and other small emission sources that could contribute to air quality changes in the region. The non-project sources combined with the project sources to form a cumulative effect that contributions to changes in air quality. These changes could add to the pollutant concentration, possibly exceeding the Northern Cheyenne's PSD Class I area for the annual NO_2 and 24-hour PM_{10} increment standards. If site- specific analysis indicates these contributions would add to the pollutant concentration on the Lame Deer nonattainment area resulting in an exceedance, the tribe, state and the Federal Government would require mitigation measures to reduce and control the contributing sources of CBNG emissions.

The Crow Reservation would experience similar changes in air quality, but due to the reservation's classification as a PSD Class II area would not likely experience any exceedance of standards.

With regards to visibility, the air model indicates that the Crow and Northern Cheyenne reservations would experience some form of reduced vision or increased haze. Visibility impacts would increase under predicted cumulative impacts from project and non-project emissions. For more detailed discussions regarding Air Quality changes to the reservations see the Air Quality section of this chapter.

Potential effects to cultural artifacts, TCPs and wildlife would be mitigated by site-specific protective and control measures developed to reduce and/or eliminate detrimental changes.

Alternative C—Emphasize CBNG Development

The differences in management objectives for Alternative C that would affect ITAs are the direct discharge of a portion of untreated production water and to some extent, the removal of the directional drilling and multiple completion requirements. Impacts to air quality, visibility, cultural resources, wildlife and social services and infrastructure would be the same or similar to those described for Alternative B.

Important to note is that, depending on the water quality criteria developed by the MDEQ, various levels of impacts on surface water would occur. If the criteria imposed were to be relatively conservative, the discharge of CBNG produced water would be limited into watersheds of both low and high water quality, resulting in minimal surface water quality impacts and increased treatment and use of alternative disposal methods. On the other hand, if the criteria were to be somewhat liberal and allow untreated discharge of produced CBNG water into

watersheds of higher quality, then impacts such as the following would be experienced: increased soil erosion and a corresponding increase in the addition of suspended sediment to surface waters adjacent to CBNG development; the elevation of existing SAR, EC and bicarbonate values for streams and rivers used by the tribes for irrigation; and the increase in flow that would result in riparian erosion and river course changes. These impacts are discussed in further detail in the *Hydrology* section of this chapter.

Impacts on groundwater would consist of the same drawdown effects as described in Alternative B. The development of federal minerals near the reservations would increase the rate at which the groundwater is removed and discharged to the surface. Additionally, impacts on shallow aquifers from the infiltration of untreated produced water are expected where the soils have a coarser texture (sandy to loamy) and good internal drainage (ALL 2001a), which would allow infiltration of produced water into subsoil-thereby impacting shallow aquifers. Some of the shallow aquifers adjacent to reservation boundaries would be affected by this type of short-term infiltration.

The discharge of untreated produced water into drainages and ephemeral watercourses adjacent to well sites would cause an overall increase in erosion leading to gullying. Based on the *Soils Technical Report* (ALL 2001a), much of the soil would likely be susceptible to increasing sodicity when irrigated or land applied with water having a high SAR (generally greater than 12). The long-term consequence is an anaerobic, waterlogged, saline/sodic soil that can be reclaimed, but would be very difficult to mitigate.

Drainage of Native American CBNG resources by adjacent production would be similar to that described for Alternative B for adjacent production. Site-specific conditions control methane liberation and collection and therefore, to evaluate potential drainage, a case-by-case drainage determination is necessary.

Encroachment on the Absaloka Coal Mine by CBNG development would inhibit future coal resource recovery. Impacts associated with the groundwater drawdown would also occur. This is discussed further in the *Geology and Minerals* section of this chapter.

Conclusion

Impacts from management decisions included in Alternative C would result in impacts to surface water quality. State and private development would reduce groundwater availability and cause the irreversible loss of fluid minerals.

The impacts to surface water quality would be greater than described in Alternative B, but the biggest factors influencing water quality would be the creation of a Water Quality Agreement between Montana and Wyoming and the implementation of water quality criteria regarding degradation of Montana watersheds by the MDEQ. CBNG development on reservations would further increase the SAR value of available surface waters, adding to the chain reaction of impacts associated with erosion, sedimentation, riparian damage and land use applications.

Impacts on the Northern Cheyenne's water right in the Tongue River Reservoir would be as described under Alternative A.

Impacts on groundwater drawdown and availability would be similar to those explained under Alternative B. Drawdown adjacent to the reservations would be increased.

Monitoring and drainage analysis would be necessary to evaluate the case-by-case CBNG drainage of adjacent fields. As stated under Alternative B, the timely development of CBNG on reservations would reduce the potential for adjacent mineral drainage, but would increase the likelihood of proximity-related impacts to the Absaloka Coal Mine.

The impacts on lands irrigated by streams and rivers receiving untreated CBNG discharge would be as described in the *Soils Technical Report* (ALL 2001a) and would be greatly dependent on the altered quality of the particular watershed being used. Increased soil erosion leading to gullying would be a result of development on the reservations along with erosion outside reservation boundaries.

Impacts to air quality, visibility, cultural resources, wildlife, social services and infrastructure would be the same or similar to those described for Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

The only differences in management objectives for Alternative D that would have an effect on ITAs is the treatment and piped conveyance of production water. This difference would reduce the impacts to erosion along ephemeral drainages, lower the sediment load in watercourses and limit the water quality impact to both surface water and

groundwater. There would be an increase in available surface water for beneficial reuse because of the required treatment and lack of conveyance losses from the piped system of discharge. The lack of conveyance losses would increase the flow in receiving watercourses resulting in course changes and riparian alterations, as identified in Alternative A.

Groundwater drawdown would be as described in Alternative B because of the use of the buffer zone by the BLM. Mineral drainage also would be the same as discussed under Alternative B, with the use of monitoring required to evaluate the case-by-case field conditions. Irrigated lands would be less affected by the use of treated waters, as described in the *Soils* section of this chapter. The Absaloka Coal Mine would experience the same groundwater drawdown impacts as described under Alternative B. Impacts to visibility, cultural resources, wildlife, social services and infrastructure would be the same or similar to those described for Alternative B on all reservations. Impact to air quality on all reservations would be lower than Alternative B.

Conclusion

Impacts from management decisions included in Alternative D, management practices common to all alternatives and from projects evaluated under the cumulative effects analysis would result in increased surface water flow, reduction of groundwater availability and the irreversible loss of fluid minerals.

Impacts on surface water quality would be similar to those discussed under Alternative B with regard to the influence of Wyoming's CBNG production waters entering Montana and affecting the Northern Cheyenne water right in the Tongue River Reservoir. With the increase in flow from the treated waters in Montana, the overall SAR values would be adjusted downward, but only slightly. CBNG development on reservations would further add to available surface waters once treatment is administered; groundwater drawdown would be the same as discussed in Alternative B. Soil erosion would be decreased because of the use of conveyance systems, which would result in the reduction of suspended solids in watercourses and the elimination of gullying. The impacts on lands irrigated by streams and rivers receiving treated CBNG discharge would be reduced. Impacts to air quality, visibility, cultural resources, wildlife, social services and infrastructure would be the same or similar to those described Alternative B. Impacts to air quality on all reservations would be lower than those discussed under alternative B.

As stated under Alternative B, the timely development of CBNG on reservations would reduce the potential for adjacent fluid minerals drainage, but would increase the likelihood of proximity-related impacts to the Absaloka Coal Mine.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

The management objectives for Alternative E would result in surface water, groundwater and potential methane drainage impacts similar to those described under Alternative E in the *Hydrology* section. Noteworthy are the approved Draft Surface Water Quality Standards of the Northern Cheyenne Tribe, which if approved by EPA, could result in restricted discharges in the Tongue River and Rosebud Creek. Regardless of what choice is made, impacts would resemble those described under Alternative E in the *Hydrology* section of this chapter. There would be no discharge of produced water (treated or untreated) into the watershed unless the operator has an approved NPDES permit and can demonstrate in their Water Management Plan how discharge could occur in accordance with water quality laws.

Impacts on groundwater would consist of the same drawdown effects as described in Alternative B, however, implementation of the BLM mitigation measures would reduce the likelihood that reservation water resources would be drained from off-reservation CBNG activities.

Water quality impacts from infiltration would be minimized as a result of the design and placement of impoundments. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts to soil, water, vegetation and channel stability reducing infiltration impacts to groundwater quality. In addition, impoundments are required to be permitted under the MDEQ General MPDES permit that includes additional conditions to minimize impacts to groundwater (see Hydrology Appendix).

Impacts on Native American hydrocarbons via adjacent production drainage would be similar to those described for Alternative C. As previously mentioned, site-specific conditions control methane liberation and collection and therefore, to evaluate potential drainage, a case-by-case study is necessary. These studies would be required as part of the APD approval process, along with intensified monitoring to determine when and if tribal CBNG resources

would be drained. If drainage is likely, the BLM would require the operator to take appropriate action, in consultation with the tribes, to reduce or eliminate the drainage, or in the case of a federal well, to compensate the tribe for the loss.

As discussed earlier under Alternative C, the Absaloka Coal Mine could be encroached on by CBNG development but wells could not be drilled within permitted coal mining acres. The coal is held in trust for the Crow Tribe.

As for impacts to air quality, visibility, cultural resources, wildlife, social services and infrastructure these would be reduced from those described under Alternative B because of the control measures employed with each site-specific Project Plan and the other management features of this alternative discussed in Chapter 2.

Mitigation measures have been developed to protect the Northern Cheyenne Tribal resources, as well as culturally important off-reservation sites. A discussion of these mitigation measures is presented in the Northern Cheyenne Mitigation Appendix. These mitigation and monitoring measures have been designed to provide the BLM and the tribe with additional information regarding measures that would be used to protect site-specific resources such as groundwater, CBNG, air quality, wildlife, vegetation and cultural resources.

Conclusion

Impacts from management decisions included in Alternative E have the potential to result in a slight decrease to surface water quality and a minimal reduction in groundwater availability.

Impacts to the Northern Cheyenne's water right in the Tongue River Reservoir would be as described under Alternative A.

Potential impacts on reservation groundwater drawdown and availability would be mitigated by the implementation of specific BLM control measures. Potential impacts to groundwater would be identified early by the intensified monitoring planned under Alternative E.

Monitoring and drainage analysis would be conducted by the BLM to evaluate the potential for CBNG drainage. If monitoring indicated tribal resources were impacted measures such as production decreases or well shut-in would be instituted and the appropriate tribal compensation agreement implemented.

The impacts to lands irrigated by streams and rivers receiving CBNG discharge would be minimal as only slight alterations in surface water quality are anticipated.

Impacts to air quality, visibility, cultural resources, wildlife, social services and infrastructure would be reduced from those described under Alternative B because of the mitigation measures employed with each site specific Project Plan and the other management features of this alternative discussed in Chapter 2. Cultural resources include important off-reservation hunting, fishing and plant gathering sites.

Impacts to the Northern Cheyenne Reservation resources would be mitigated by the implementation of control measures described by the BLM in the Northern Cheyenne Mitigation Appendix.

Alternative F—Phased Development Multiple Screens (High Range)

Alternative F would result in reduced surface water, groundwater and methane drainage impacts to Indian Trust Assets as compared to Alternative E. This is due to the use of the 5-mile buffer zone, the 10 percent of the 7Q10 discharge threshold for federal minerals and enforcement of additional monitoring requirements for federal mineral development within this zone.

The MDEQ has set numerical criteria for surface water discharges within the Powder River Basin watersheds. These standards are displayed in Table 3-6. Direct, untreated discharge into stream is no longer permitted. Some existing operations obtained permits prior to this ruling and may continue to discharge limited amounts (1,600 to 2,500 gpm) of untreated CBNG produced water directly into the Tongue River. These permits are flow-based and allow increased regulated discharges during certain higher flow conditions. The new permit standards may result in restricted discharge to most rivers and streams in the CBNG emphasis area. This restricted discharge would most likely increase impoundment use, either as a means of disposal or storage prior to treatment. Regardless of what choice is made, impacts would resemble those described under Alternative F in the *Hydrology* section of this chapter. There would be no, or very limited, discharge of produced water (treated or untreated) into the watersheds from federally developed minerals due to the curtailment of the discharge by the threshold limit of 10 percent of the 7Q10.

Impacts on groundwater would consist of the same drawdown effects as described in Alternative B; however, implementation of the BLM mitigation

measures coupled with the 5-mile monitoring proximity would further reduce the likelihood that any reservation water resources would be drained from off-reservation federal CBNG activities. Current monitoring at the CX field as gauged by 162 monitoring wells indicate that draw-down measurements after more than four years of production are 20 feet extending 1-2 miles (Wheaton and Donato 2004). Groundwater monitoring indicates drawdown is "similar to but somewhat less than expected" from the groundwater modeling conducted for the Statewide Document (Wheaton et al. 2005).

Water quality impacts from infiltration would be minimized as a result of the design and placement of impoundments. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts to soil, water, vegetation and channel stability reducing infiltration impacts to groundwater quality. In addition, any impoundments within 5-miles of the reservations would be monitored for infiltration effects to groundwater quality.

Impacts on Native American hydrocarbons via adjacent state or private production drainage would be similar to those described for Alternative C. The required drainage analysis and follow-up studies for operators extracting federal minerals within 5 miles of the reservations would further reduce the likelihood of tribal resources being drained. If drainage is determined to be likely, the BLM would require the operator to take appropriate action. The action would consist of consultation with the affected tribes, implementation of measures to reduce or eliminate the drainage, or in the case of a federal well, shut-in production until a later date when the drainage issue can be mitigated.

As discussed earlier under Alternative C, the Absaloka Coal Mine could be encroached on by CBNG development but wells could not be drilled within permitted coal mining acres. The coal is held in trust for the Crow Tribe.

The potential for impacts to air quality, visibility, wildlife, social services and infrastructure would be less than under Alternative E because of the control measures employed with each site-specific Project Plan and the general leveling out of the development pace for CBNG across the basin. More comprehensive air quality analysis and possibly monitoring would also be required for PODs submitted within 5 miles of the reservation exterior boundary.

Mitigation measures would help protect Northern Cheyenne tribal resources and off-reservation sites, such as the Rosebud and Wolf Mountain Battlefields, known to be of special importance to the tribe. A discussion of these mitigation measures is presented in the Northern Cheyenne Mitigation Appendix. These mitigation and monitoring measures have been designed to help protect resources such as groundwater, CBNG, air quality, wildlife, vegetation and off-reservation cultural resources of special interest to the tribe.

The Northern Cheyenne Tribe also has off-reservation properties held in trust that consist of two, tracts of land, approximately 160 acres each, in the vicinity of the Tongue River Reservoir. The tribe also acquired off-reservation surface estate consisting of the Moreland Ranch property. The mineral estate for the Moreland Ranch property is owned by the Consolidated Coal Company and could be subject to development; however it is currently not leased. The BLM would consult with the tribe to determine what mitigation measures are needed to protect the surface use of the ranch. Tribal buffalo herds are pastured at the Moreland Ranch property.

With regard to off-reservation TCPs and cultural artifacts the BLM has implemented a cultural survey requirement for the majority of CBNG lands to be developed under each POD. The use of these "block surveys" coupled with tribal consultation requirements has demonstrated the ability to identify the majority of sites that could be affected and reduce the potential impacts associated with developing CBNG in the vicinity of cultural resources.

Furthermore, on January 12, 2006, the BLM Montana State Office issued additional cultural resource requirements for oil and gas operations in Montana and the Dakotas. These requirements are intended for both oil and gas operators and cultural resource consultants hired by oil and gas operators. They supplement the *Guidelines for Identifying Cultural Resources H-8110-1* (the handbook) which remains the basic guidance for cultural resource work completed for BLM undertakings. Notice to Lessees, NTL-MSO-1-85, provides guidelines to operators when they are required to conduct cultural resource inventories. The NTL establishes the minimum survey area of 10 acres centered on each proposed well plus the access road, pipeline and ancillary areas subject to surface disturbance. Washington Office IM No. 2003-147 (BLM 2003c) recommends block surveys ranging from 40 acres for individual wells to entire lease or full field development areas for large-scale projects to improve the APD process. Block surveys offer many advantages including reducing the probability that multiple surveys will be required to site a single project. Additionally, operators are

encouraged to complete cultural resource surveys prior to the onsite inspection. This will allow the well location and/or access route to be sited prior to the onsite in order to avoid adverse effects on cultural resources and reduce the likelihood of having to change a location due to a cultural resource conflict discovered later in the APD review process.

Conclusion

Impacts from management actions under Alternative F have the potential to preserve surface water quality and minimize the drawdown of groundwater on the reservations.

Impacts to the Northern Cheyenne Tribe's water right in the Tongue River Reservoir would be as described under Alternative A.

Potential impacts on reservation groundwater drawdown and availability would be mitigated by the implementation of specific BLM control measures. Potential impacts to groundwater would be identified by the use of the 5-mile analysis requirement under Alternative F.

Monitoring and drainage analysis would be conducted by the BLM and operators to evaluate the potential for CBNG drainage. If monitoring indicated tribal resources were to be impacted measures such as production decreases or well shut-in would be instituted.

The impacts to lands irrigated by streams and rivers receiving CBNG discharge would be further reduced as only state and private untreated discharge would be likely.

Impacts to air quality, visibility, wildlife, social services and infrastructure would be reduced from those described under Alternative E because of the pace of development coupled with existing mitigation measures employed with each site specific Project Plan.

Cultural resources, including important off-reservation hunting, fishing and plant gathering sites would be identified within the POD development process due to the use of surveys and tribal consultation efforts.

Alternative G—Phased Development Multiple Screens (Low Range)

Effects under Alternative G would be the same as Alternative F but would be reduced by approximately 65 percent based on the fewer number of APDs that are predicted to be issued. Under Alternative G, the annual cumulative limit placed on federal APDs approved by BLM would be set at five percent (323 APDs) of the low-range of state, private and federal CBNG APDs (6,470) predicted to be approved in the Planning Area (as identified in the Reasonably Foreseeable Development scenario in the Statewide Document). This would result in a 65 percent reduction in activities related to CBNG development that could potentially have an effect on tribal resources or off-reservation sites of special interest.

Alternative H—Preferred Alternative - Multiple Screens

Under this Alternative, impacts to federal leases, CBNG resources and federal lessees would be similar to Alternative F. This Alternative manages the pace (rate) and place (geography) of federal CBNG development through protection measures applied to crucial habitat areas and limits to the discharge of untreated produced water from federal CBNG wells and emissions from sources associated with federal CBNG wells. More federal APDs could be approved annually and geographically than under Alternatives F and G as long as other resources are protected. Monitoring data would be required to help BLM determine which (where and when) federal APDs could be approved. These limits and thresholds (see Wildlife Appendix and Hydrology section) would serve to level the cumulative impacts over time. The production of CBNG would continue for a longer overall period of time compared to Alternative E because fewer number of federal CBNG wells may be drilled each year.

Alternative H would result in reduced surface water, groundwater and methane drainage impacts to Indian Trust Assets as compared to Alternative E. This is due to the use of the 5-mile buffer zone and enforcement of additional monitoring requirements for federal mineral development within this zone.

The MDEQ has set numerical criteria for surface water discharges within the Powder River Basin watersheds. These standards are displayed in Table 3-6. Direct stream discharge is no longer permitted on new wells. Existing operations were "grandfathered" in and are discharging directly into streams. Also, proposals are being considered to allow regulated discharges during certain flow conditions. These efforts would result in restricted discharge to most rivers and streams in the CBNG emphasis area and flow based discharge with increased impoundment use. Regardless of what choice is made, impacts would resemble those described under Alternative H in the Hydrology section of this chapter. There would be no or very limited discharge of produced water (treated or

untreated) into the watersheds from federally developed minerals due to the curtailment of the discharge by the threshold limit of 10 percent of the 7Q10.

Implementation of the BLM mitigation measures coupled with the 5-mile monitoring proximity would reduce the likelihood that any reservation groundwater resources would be drained from off-reservation federal CBNG activities. Current monitoring at the CX field as gauged by 162 monitoring wells indicates that drawdown measurements after more than four years of production are 20 feet extending 1-2 miles (Wheaton and Donato 2004). Groundwater monitoring indicates that drawdown is "similar to but somewhat less than expected" from the groundwater modeling conducted for the Statewide Document (Wheaton et al. 2005)

Water quality impacts from infiltration would be minimized as a result of the design and placement of impoundments. Impoundments proposed as part of the Water Management Plan would be designed and located to minimize or mitigate impacts to soil, water, vegetation and channel stability reducing infiltration impacts to groundwater quality. In addition, any impoundments within five miles of the reservations would be monitored for infiltration effects to groundwater quality.

Impacts on Native American hydrocarbons via adjacent state or private production drainage would be similar to those described for Alternative B. The required drainage analysis and follow-up studies for operators extracting federal minerals within five miles of the reservations would further reduce the likelihood of tribal resources being drained. If drainage is determined to be likely, the BLM would require the operator to take appropriate action. The action would consist of consultation with the affected tribes, implementation of measures to reduce or eliminate the drainage, or in the case of a federal well, shut-in production until a later date when the drainage issue can be mitigated.

The Absaloka Coal Mine could be encroached on by CBNG development but wells could not be drilled within permitted coal mining acres. The coal is held in trust for the Crow Tribe. Encroachment on the Absaloka Coal Mine by CBNG development would create impacts associated with the groundwater drawdown. Increased coal bed aquifer drawdown could benefit the mine from methane extraction prior to coal removal, but could hinder and complicate aquifer restoration efforts once mining activities cease. In addition, the removal of coal seam water may create a situation where the coal mine would need to purchase water for dust control.

The potential for impacts to air quality, visibility, wildlife, social services and infrastructure would be less than under Alternative E because of the use of the air quality screen. The screen would be used to require modifications be made to existing operations if observed effects and modeled impacts completed for the annual review by MDEQ show that state or federal regulatory standards would be exceeded. Under these circumstances the BLM could disapprove additional CBNG APDs if available monitoring and air modeling of new proposals indicated effects that violate state or federal regulatory standards. In such cases BLM would first consider mitigation measures that would reduce impacts so that actions would comply with such standards. Furthermore, management direction under this alternative requires control measures to be employed with each site-specific Project Plan, maximum number of wells connected to each compressor and use of natural gas or electrical compressors only.

Mitigation measures would help protect Northern Cheyenne Tribal resources and off-reservation sites, such as the Rosebud and Wolf Mountain battlefields, known to be of special importance to the tribe. A discussion of potential mitigation measures is presented in the Northern Cheyenne Mitigation Appendix. These mitigation and monitoring measures have been designed to help protect resources such as groundwater, CBNG, air quality, wildlife, vegetation and off-reserbation cultural resources of special interest to the tribe.

The Northern Cheyenne Tribe also has off-reservation properties held in trust that consist of two tracts of land, approximately 160 acres each, in the vicinity of the Tongue River Reservoir. The tribe also acquired off-reservation surface estate consisting of the Moreland Ranch property. The mineral estate for the Moreland Ranch property is owned by the Consolidated Coal Company and could be subject to development; however it is currently not leased. The BLM would consult with the tribe to determine what mitigation measures are needed to protect the surface use of the ranch. Tribal buffalo herds are pastured at the Moreland Ranch property.

With regard to off-reservation TCPs and cultural artifacts the BLM has implemented a cultural survey requirement for the majority of CBNG lands to be developed under each POD. The use of these "block surveys" coupled with tribal consultation requirements has demonstrated the ability to identify the majority of sites that could be affected and reduce the potential impacts associated with developing CBNG in the vicinity of cultural resources.

Furthermore, on January 12, 2006 the BLM Montana State Office BLM issued additional cultural resource requirements for oil and gas operations in Montana and the Dakotas. These requirements are intended for both oil and gas operators and cultural resource consultants hired by oil and gas operators. They supplement the *Guidelines for Identifying Cultural Resources H-8110-1* (the handbook), which remains the basic guidance for cultural resource work completed for BLM undertakings. Notice to Lessecs, NTL-MSO-1-85, provides guidelines to operators when they are required to conduct cultural resource inventories. The NTL establishes the minimum survey area of 10 acres centered on each proposed well plus the access road, pipeline and ancillary areas subject to surface disturbance. Washington Office IM No. 2003-147 (BLM 2003c) recommends block surveys ranging from 40 acres for individual wells to entire lease or full field development areas for large-scale projects to improve the APD process. Block surveys offer many advantages including reducing the probability that multiple surveys will be required to site a single project. Additionally, operators are encouraged to complete cultural resource surveys prior to the onsite inspection. This will allow the well location and/or access route to be sited prior to the onsite in order to avoid adverse effects on cultural resources and reduce the likelihood of having to change a location due to a cultural resource conflict discovered later in the APD review process.

Conclusion

Impacts from management actions under Alternative H would be the same as under Alternatives F and G.

Potential impacts on reservation groundwater drawdown and availability would be mitigated by the implementation of specific BLM control measures. Potential impacts to groundwater would be identified by the use of the 5-mile analysis requirement.

Monitoring and drainage analysis would be conducted by the BLM and operators to evaluate the potential for CBNG drainage. If monitoring indicated tribal resources were to be impacted measures such as production decreases or well shut-in would be instituted.

The impacts to lands irrigated by streams and rivers receiving CBNG discharge would be further reduced as only state and private untreated discharge would be likely.

Impacts to air quality, visibility, wildlife, social services and infrastructure would be reduced from those described under Alternative E because of the pace of development coupled with existing mitigation measures employed with each site specific Project Plan

Cultural resources, including important off-reservation hunting, fishing and plant gathering sites would be identified within the POD development process due to the use of surveys and tribal consultation efforts.

Lands and Realty

Lands and Realty

Planning Area Land Ownership:
- *Private 69%*
- *Federal 15%*
- *Tribal 10%*
- *State 5%*

Total Acreage:
19,371,593

Miles of Road:
- *Interstate, 386*
- *US, 675*
- *State, 409*
- *Off-System, 24,431*

Miles of Railroad:
- *Burlington Northern Santa Fe (BNSF), 573*
- *MontanaRail Link, 146*

Alternative A
No Action (Existing CBNG Management)

- Federal:
  - Minimal land area displaced by roads.
  - 400 acres disturbed during CBNG exploration drilling.
- State:
  - Increased motorized access on the CX Ranch.
  - Increase motorized trespass.
  - 1,100 acres disturbed during CBNG exploration and production activities.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Federal:
  - Increase fire hazard and motorized access.
  - 25,600 acres disturbed during CBNG development activities.
- State:
  - Displace agricultural lands.
  - Disrupt irrigation system, increase cost of farm operation.
  - Reduced property values.
  - Displace community and residential growth.
  - Increase dust and noise impacts on residential use.
  - Increased cost of county road maintenance.
  - Increase long-term motorized access.
  - 29,750 acres disturbed during CBNG development.

Alternative C
Emphasize CBNG Development

- All impacts in Alternative B occur in Alternative C in addition to:
  - The land use displacement from roads and utility lines during lease operations is greatest in Alternative C
  - 70,000 acres would be disturbed by CBNG activities on private, state and federal lands

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- All impacts in Alternative B occur in Alternative D in addition to:
  - Federal: Permanent loss of land use from road network.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Levels of disturbance would be 27 percent greater than Alternative B because transportation corridors and the use of existing disturbed lands would not be required for roads and utilities.
- Impacts from power lines, roads, pipelines and other utilities not requiring transportation corridors would be the same as Alternative C.

Alternative F
High Range Phased CBNG Development

- Federal:
  - 25,600 acres disturbed during CBNG exploration and construction activities (short-term).
  - 15,250 acres disturbed during operation (long-term).
- State:
  - 29,550 acres disturbed during CBNG exploration and construction activities (short-term).
  - 17,600 acres disturbed during operation (long-term).
- 88,170 acres cumulative effects.
- If no development occurs in crucial sage-grouse habitat, cumulative impacts would be reduced to 82,527 acres (6.4% reduction from 88,170 acres).

Alternative G
Low Range Phased CBNG Development

- Levels of disturbance are 65 percent less than Alternative F.
- Federal:
  - 9,100 acres disturbed during CBNG exploration and construction activities (short-term).
  - 5,400 acres disturbed during operation (long-term).
- State:
  - 10,500 acres disturbed during CBNG exploration and construction activities (short-term).
  - 6,250 acres disturbed during operation (long-term).
- 20,450 acres cumulative effects.

Alternative H
Preferred Alternative

- Federal:
  - 25,600 acres disturbed during CBNG exploration and construction activities (short-term).
  - 15,250 acres disturbed during operation (long-term).
- State:
  - 29,500 acres disturbed during CBNG exploration and construction activities (short-term).
  - 17,600 acres disturbed during operation (long-term).
- 88,170 acres cumulative effects.

Assumptions

Gas from CBNG wells is normally measured at the well site or on a collection line before mixing at field compression stations, making it possible for flow lines and compression stations to be shared by different operators to reduce development cost and surface disturbance.

Split estate surface owners have the right to maintain control of non-CBNG related access.

Operators are responsible for communicating requirements and stipulations to independent contractors working on behalf of the operator when performing various phases of CBNG exploration and production development.

There are no expected disruptions to existing fiber optic, phone, gas, electric, or water lines as a result of the construction, production, or abandonment of project alternatives. It is the responsibility of the operator to identify and avoid buried lines within the pathway of new surface-disturbing activities.

According to the Farmland Protection Policy Act, federal agencies involved in proposed projects that may convert farmland to non-agricultural uses must complete a USDA Farmland Conversion Impact Rating Form AD-1006. The form focuses on two farmland designations: prime farmland and agricultural lands of statewide importance. Prime farmland and agricultural lands designations are based on soil type and productivity and are not based on present use. The AD-1006 form would be completed for each APD application or as part of an Environmental Assessment (EA) checklist to assess impacts to agriculture on federal lands.

No physical displacements of residences or commercial property would result from project alternatives.

CBNG-related, human activity increases fire hazards in the Planning Area. The loss of vegetation by fire would impact all land uses including ranching, recreation and agriculture and would limit access to public lands because reclamation would be sensitive to soil disturbance.

The required reclamation plan by the operator would be reviewed and approved by BLM on federal lands, by the state on state lands and by the landowner on private lands.

Impacts from Management Common to All Alternatives

Potential land use impacts would primarily consist of conflicts between conventional oil and gas activities and other uses of property, such as agriculture, residences and coal mines. New authorizations for major gathering lines, major transportation lines and power lines, for example, would impact rights-of-way (ROWs) and land segmenting. The development of oil and gas resources impacts agricultural production by taking land out of production and by soil contamination from drilling and production activities.

Surface disturbance associated with oil and gas activities, such as roads, well pads and battery sites would remove those areas of agricultural production during the life of the road, well pad, or tank battery site. Removal of vegetation would reduce the acreage available for livestock grazing or crop production. Buried flowline and utility line routes would be seeded so the acreage would be temporarily removed from use for grazing or crop production. The infrastructure associated with oil and gas production could affect the movement or area available for livestock and could hinder irrigation systems.

Most existing roads would be lightly traveled by local residents, ranchers and oil and gas workers. Use of unimproved roads would increase because of daily operations for a month at each site during development and testing of exploration wells. This road activity would be increased in general areas targeted for well development. Unimproved roads would be vulnerable to damage in adverse weather conditions. Public and private lands could be impacted by driving on soft or unstable road surfaces.

Residents and public visitors would be impacted by the sights, sounds and delays caused by the construction and testing of exploratory and production wells. An increase in slow-moving vehicles would be an impact in areas not currently experiencing these activities. Creation of a temporary, unimproved, unrestricted access road to an area would allow public access and exposure of the property in a new way and would expand the road system requiring maintenance by federal or state agencies and private landowners.

Public access to most wells would likely be limited because 69 percent of the land area is private; however, there would be conflicts with recreation (see the *Recreation* section of this chapter). Short-term impacts would occur during road building, pad development, drilling and production-related

activities. Access for recreation on legally accessible public lands would increase as a result of the increase in unimproved roads. These impacts would be viewed as a benefit to sportsmen, who generally support increased vehicle access. Road densities on private lands would likely increase in the areas targeted for oil and gas wells, but property owners would be responsible for access control.

CBNG development would increase the likelihood of fire because there would be potential incendiary activities occurring where none now occur. Specific causes may include methane leaks, electrical fires from drilling and other construction activities, fires from ruptured gas pipelines, careless smokers, gas migrating from domestic wells contaminated with methane gas and hot catalytic converters on vehicles.

Produced water of quality suitable for livestock could be placed in impoundments in areas currently without such impoundments for livestock. This would enhance or expand livestock grazing. Construction disturbance would also force cattle onto previously unused range, further changing land use (see discussion on Livestock Grazing). Similar displacement would occur for wildlife, disrupting hunting on land designated for controlled or general hunts.

There may be a trespass impact to private landowners from the conversion of unroaded federal lands with a right-of-way that now allows access to private lands.

On private and public lands, road maintenance would be specified in the lease agreement, drilling permit or Right of Way as the responsibility of either the contractor or landowner.

Complete removal of the indication of vehicle passage and revegetation of two-track exploration on public lands would be important to prevent these temporary roads from becoming an established access through consistent misuse by four-wheel-drive and all-terrain vehicles, especially in areas historically not accessed by vehicles. The Vegetation section describes the seeding policy for reclaiming surface disturbances.

Activities other than those associated with CBNG production are expected to result in additional land disturbance. These activities include conventional oil and gas, active coal mines, fires, highway projects, power plants and the proposed Tongue River Railroad.

The proposed Tongue River Railroad would require the acquisition of 447 to 636 acres for the ROW. Land within the ROW would be lost to its present use and some parcels would be intersected by the rail line, possibly resulting in a change in existing use. Construction of the railroad would increase vehicle use and maintenance of local roads in the project area over the short term, while travel along these roads would also be affected over the long term by delays from grade-level train crossings (STB 2004).

Impacts From Management Specific To Each Alternative

Alternative A—No Action (Existing CBNG Management)

Impacts on multiple uses of public lands would be minimal because there would be no CBNG production development on federal lands. State and private lands would have limited CBNG production activities.

Exploration

The amount of new roads to be built would be minimal relative to other alternatives. The primary land use impacts on federal and state lands are from short-term direct land use displacement by exploratory well pads and the creation of two-track trails across prairie or other lands from exploratory equipment. Impacts on private lands would be largely addressed in the contractual agreement with the private owners of the CX Ranch.

Production

Newly created roads for CBNG production would increase access across the CX Ranch that may displace or change the land use patterns on the land.

Abandonment

Two-track trails and associated motorized access created by CBNG exploration on federal and state lands would be reclaimed after abandonment, unless otherwise authorized. New access created under a ROW may be reclaimed depending on the situation and the BLM and surface owner's requirements. New motorized access in watersheds targeted for water quality restoration by MDEQ may require road reclamation as part of abandonment. Reclamation based on water quality would be on a case-by-case basis with involvement from MDEQ. Abandonment and reclamation of roads on the CX Ranch could be highly variable according to the agreement with the surface owner. Abandonment impacts on private land cannot be determined because of its variability, but private landowners would be able to negotiate reclamation agreements to avoid long-term impacts to their land. Unwanted roads on the CX Ranch

would be obliterated and revegetated according to the agreement with the lease operator.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative A. If there were no CBNG development on tribal Lands, then there are expected to be minimal, if any, impacts to the reservation. Trespassing from CBNG related vehicles might increase because of activities adjacent to the reservation. Traffic is also expected to increase on reservation roads.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation. Traffic is also expected to increase on reservation roads.

Conclusion

Alternative A would have the least land use impact among alternatives because of the limited number of exploration and production wells within the Planning Area. The greatest potential land use impact would be the ranching disturbance and displacement on the CX Ranch (see the *Livestock Grazing* section of this chapter). Approximately 500 acres of surface area would be disturbed (Table 4-56), which is less than 0.01 percent of the total Planning Area.

Cumulative impacts are estimated to be approximately 41,070 acres of disturbance from CBNG related and other activities within the Planning Area. The cumulative impacts comprise less than 1 percent (0.21 percent) of the entire Planning Area.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Exploration and Production

Short-term impacts of land uses during construction would consist of the physical intrusion by CBNG crews and equipment, the local generation of dust and noise and the limited obstruction of traffic. Long-term impacts include loss of existing land use, increased access from roads and loss of land value.

Some surface landowners are unaware of the severed mineral rights and even though compensated, would be displeased with the possibility of having well facilities located near dwellings. There are no legally required buffer distances between CBNG facilities and residential, community, or government dwellings. Placement of roads and well pads near residential, business and community dwellings may cause direct reduction of property values.

TABLE 4-56

ACRES OF LAND DISTURBANCE FOR CBNG WELL EXPLORATION, CONSTRUCTION AND OPERATION BY ALTERNATIVE

Alternative	Number of Wells	Acres of Short-term Land Disturbance (Exploration and Construction)			Acres of Long-term Land Disturbance (Operation)			Total Acres of Cumulative Effects[1]
		Federal Wells	State/Private Wells	Total	Federal Wells	State/Private Wells	Total	
A	675	400	1,100	1,500	0	500	500	**41,070**
B and D[2]	18,275	25,600	29,750	55,350	15,250	17,700	32,950	**88,270**
C[2,3]	18,275	32,400	37,600	70,000	22,000	25,600	47,600	**109,497**
E[2,3]	18,275	34,250	39,750	74,000	20,350	23,650	44,000	**99,370**
F and H[2,4]	18,225	26,600	29,550	55,150	15,250	17,600[4]	32,850	**88,170**
G[2]	6,470	9,100	10,500	19,600	5,400	6,250	11,650	**20,450**

[1] Cumulative effects include long-term acres of disturbance from CBNG well operation (BLM, state and other) and other projects or activities identified in the RFD. Other projects or activities included in the cumulative effects total an additional 41,070 acres as described in the Minerals Appendix.

[2] Ten percent of CBNG wells are predicted to be dry holes. Acres of disturbance for these wells are considered to be the same as for exploration. Consequently, only 90 percent of the predicted wells would result in long-term land disturbance from construction and operation.

[3] The long-term direct impacts and the length of roads and corridors would be 27 percent greater for Alternatives C and E than for Alternatives B, D and F because transportation corridors and the use of existing disturbed lands would not be required for roads and utilities under Alternatives C and E.

[4] Fifty fewer state wells are included for Alternatives F and H because they were predicted to occur in the three counties outside the Billings and Powder River RMP areas. The difference in total acres of land disturbance from these wells is small relative to the total acres of land disturbance from all predicted wells.

Although there may be no statute that covers buffer distances, State of Montana oil and gas leases include a minimum buffer distance of 200 feet. Reasonable additional buffers can be added as needed at the time of site-specific operating plan review, including movement up to 656 feet on Federal leases.

Impacts from placement of roads, utility lines, pipelines and well pads around communities may cause loss of future community development opportunities. These uses displace other surface uses like residential development and location of public parks and schools. There are safety and liability concerns.

Although private landowners and state land managing agencies would help decide road routes on their lands, as described in the Mitigation section, they would likely want to maintain some roads that benefit existing or future uses.

The increase in average daily traffic of U.S., interstate and state highways by action alternatives would be minor and is not expected to decrease their designed level of service within the CBNG Planning Area. Increased highway average daily traffic over the 20-year life of the project would be largely from increases in demographics.

County roads in some portions of the Planning Area would receive substantial CBNG exploration and development traffic volumes. This large influx of CBNG-related traffic on some isolated county and local roads would increase their associated road maintenance cost.

Lease operators would discuss compensation with county and local road and bridge departments when CBNG-related traffic has caused increased road maintenance cost. There may be times when an operator or a group of operators may choose to provide maintenance for a particular road.

Short-term exploration impacts to farming include seasonal loss of crops during construction, interference with irrigation patterns and increased introduction of noxious weeds.

Cropland area converted to production well pads and roads would be lost for the up to 20-year life of the project. Four percent of wells in the Powder River RMP area and 8 percent of the wells in the Billings RMP area would occur in cropland soils. Specific long-term impacts include land displacement; alteration of existing flood and center pivot irrigation systems; modification of farming operations near and around well pads and access roads; potential for proliferation of noxious weeds; surface and groundwater quality losses; farming operations that are no longer commercially viable at certain locations; economic losses associated with all of the above; and lower land values.

Direct impacts on commercial woodlands would be caused by the immediate harvest of timber in ROWs and well pad sites and the loss of timber growth in these areas during the life of production and time of regrowth to merchantable trees. The income loss for the tree growth loss is reflective of time to grow merchantable trees, which is 50 to 100 years after reclamation of ROWs and pad sites. New roads on public forest lands may become part of the existing road system and their ROWs would be a permanent loss of timber production. The increased use of four-wheel-drive and all-terrain vehicles would allow other vehicles to have extensive access once a route is established.

Roads from CBNG development and CBNG-related motorized activity may create conflict with timber cruising, logging and hauling activities of an active timber sale. CBNG-related traffic could increase traffic hazards with log-hauling trucks unless road use coordination occurs.

Indirect impacts from land clearing include wood fuel loading, introduction of noxious weeds; increases in insect population from slash buildup; and increased access for forest and fire management. CBNG-constructed roads may not always be located in the best area for managing forest resources.

Abandonment

On federal and state lands, the access plan would create fewer two-track trails and roads than other development alternatives. Utility reclamation would occur with road reclamation because they are located in the same corridor. Public access would be restricted over the life of the CBNG productions on the road network and would not become part of the permanent public access network. On private lands, road abandonment would be highly variable because each landowner agreement could be different.

Regeneration time of timber to commercial size after CBNG activities or other related land use would likely be 50 to 100 years. Road obliteration would include re-contouring the landscape and planting tree seedlings appropriate to the forest site.

Damage from a fire related to CBNG activities would be the responsibility of the operator. Liability of fire is detailed in Statute 50-63-103 MCA.

Crow Reservation

If there were no CBNG development on tribal Lands, then impacts on the reservation, other than CBNG related traffic discussed above, would be minimal.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative B.

Conclusion

Alternative B would have fourth smallest impact to present land use of the seven development alternatives (B, D, C, E, F, G & H). For example, the required use of a transportation corridor for both road and utility lines in a one-way pattern reduces the direct surface disturbance by an estimated one-third compared to a grid pattern, multiple corridor approach.

Common land use impacts from roads, pads, pipelines and utility lines include direct loss of agriculture, timber, grazing, recreation and wildlife habitat and increased potential of wildfire. Indirect impacts include limited road access; dust, noise and reduced property values; and increased local road maintenance cost, production, water storage and ground injection, which reduces the potential direct and indirect impacts to other surface land uses. Residual benefits of the road networks created for CBNG development include increased access for fighting fires and create fuel breaks.

Most direct and indirect impacts are mitigated through reclamation and financial compensation. Although minimal impacts due to dust may occur, dust abatement measures would be actively employed to minimize impacts to air quality as well as land resources. Surface owner agreements would be used to prevent avoidable impacts to residents and communities. Impacts minimized by surface owner agreements include, but are not limited to, disruption to irrigation facilities, placement of roads, pipelines and well pads. Unmitigated impacts include displaced, non-monetary uses like public access, fire hazards and noise disturbance to livestock. Alternative B is estimated to cause 32,950 acres of long-term surface disturbance (Table 4-56), which is less than 1 percent of the total Planning Area.

Cumulative impacts for Alternative B include increased fire hazards from CBNG exploration and development, which are the largest potential cumulative economic and environmental impacts to future land uses. The loss of range, timber, habitat, dwellings, access and other impacts would not be recovered for a long time. However cumulative impacts are estimated to be 88,270 acres which is less than 1 percent of the entire Planning Area.

Alternative C—Emphasize CBNG Development

The less stringent access plan, separate placement of pipelines, utility lines, lack of buffers and use of production water, would lead to an increase in surface land disturbance when compared to the other alternatives.

Exploration and Production

New production roads may be placed along existing trails or be placed in the more traditional road grid system, which allows multiple routes from any production intersection. The traditional road grid system used for CBNG production would create the highest density of roads and may increase the size of the public road network. On private lands, road placement would be a contractual agreement with the surface owner and roads may be left in place or reclaimed.

Surface disturbance from roads, pipelines and utility lines is estimated to be approximately 30 percent greater than Alternatives B and D (see Table 2-2 in Chapter 2) because there are not the same road and utility restrictions to this alternative. Surface disturbance and its impact to agriculture is similar to Alternative B because most agriculture is on private lands. The potential impacts from production water discharges are also similar for the same reason.

CBNG production water may have high levels of salinity or sodicity, which can cause negative impacts to agriculture with continued use. The saline level of the average CBNG production water is near the threshold for causing yield reduction. Reduction in yields would be expected in salinity-sensitive crops like alfalfa, corn and clover hay. High SAR production water would reduce water infiltration, especially in clay soils and would increase erosion. CBNG water with combined high SAR and low EC can cause notable reductions in the water infiltration rate of irrigated crops (ALL 2001b). Repeated sprinkler-applied CBNG water high in saline can cause salt accumulation near the soil surface and cause foliar damage to certain crops. Dewatering coal seams may lead to release of methane gas that can contaminate neighboring agricultural and residential wells (ALL 2001b). The contamination of wells is a possibility that cannot be estimated in either amount of methane per well or by proximity of a well to a CBNG field. Any contaminated well could be

rendered unusable and if the well is within a closed structure, increased ventilation is required to reduce buildup to explosive quantities.

It must be assumed that the historic road grid system used for CBNG development is a worst-case scenario allowed under this alternative when there are no existing disturbances. The road grid system would create the densest road network and largest surface disturbance by providing multiple access to all the wells in the 80-acre well spacing proposal.

Abandonment

Land use displacement from road disturbances would be an assumed 20-year loss on federal, state and private lands as in Alternative B, except there is more displacement on federal and state lands with this alternative. Land use displacement on private lands would have varying degrees of reclamation based on whether road placements benefit long-term private operations.

There is limited access to many small federal land parcels within the Planning Area. CBNG lease operators would create roads to these parcels and increase access and potential public use of the federal parcels. Neighboring private owners who have contributed access to the federal and state parcels may incur increased trespass problems similar to Alternatives B and D.

Crow Reservation

If there were no CBNG development on tribal lands, then impacts on the reservation, other than increased CBNG-related trespass problems discussed above, would be minimal.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative C.

Conclusion

CBNG management under Alternative C would result in the most impacts to present land uses among the seven development alternatives (B, C, D, E F, G & H). The disturbance is estimated to be one-third greater than Alternatives B and D. The two main causes for the increased surface disturbance and land use displacement are from use of a traditional road grid system. Surface owner agreements would be used to minimize surface disturbance due to road placement.

Overall, approximately 47,600 surface acres would be impacted, even with the increased impacts, this area is less than one percent of the Planning Area.

Cumulative impacts including the additional surface impacts total 109,497 acres for Alternative C. The increased cumulative impacts remain below 1 percent of the entire Planning Area.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Short-term transportation impacts on federal and state land uses would be the same as Alternative B. However, the long-term transportation impacts would be greatest because road obliteration and reclamation might not occur under this alternative and would permanently displace present and future land uses. The roads would become part of the public transportation system and would increase vehicle access on federal lands. The existing public road network may receive substantial traffic during production, requiring increased maintenance cost by public agencies. The new roads on federal lands that are not reclaimed would become the maintenance responsibility of the corresponding public agency.

Crow Reservation

Impacts on the Crow Reservation would be primarily the result of vehicle trespassing.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under Alternative D.

Conclusion

Alternative D has the same short-term transportation impacts as Alternative B but has the greatest long-term land use displacement impacts from the created permanent roads. The types of land use displacement with this alternative are the same as other development alternatives. Surface owner agreements would be used to minimize impacts due to land use displacement.

Most direct and indirect impacts are mitigated through reclamation and financial compensation. Unmitigated impacts include public access, fire hazards and disturbance to livestock. Total permanent surface impacts and cumulative impacts are estimated to be the same as alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Exploration and Production

The type of impacts from roads, pipelines and utility lines in Alternative E are the same as those described in Alternative B. The extent of these impacts would be the same as described in Alternative C. This alternative, like Alternative C, would not require transportation corridors for the placement of roads, utility lines and pipelines. Existing disturbances would be used as much as possible for utility access. Management features of Alternative E include burying power lines in certain locations and requirements of a project plan to minimize impacts.

Land use displacement from road disturbances would be up to 20-years on federal, state and private lands as with Alternatives B and C. CBNG lease operators would create roads to small federal and state parcels never before road accessible to the public. Motorized trespass would be enhanced as a result of the increased road network on federal, state and private lands from CBNG-related exploration and development.

Agricultural-related impacts would be the same as those described in Alternative B.

CBNG activities increase the likelihood of fire. Road networks created for CBNG development would increase access for fighting fires.

Abandonment

Abandonment of roads, utility lines and powerlines would be the same as described in Alternative C.

On private lands, road abandonment would be highly variable as with the other alternatives because each landowner agreement would be different.

Liability of fire is detailed in Statute 50-63-103 Montana Code Annotated.

Conclusion

CBNG operators would be required to submit a Project Plan when the proposed development for an area would exceed one well per 640 acres.

The type of impacts from roads, pipeline and utility lines in Alternative E are the same as those described in Alternative B. The extent of impacts would be the same as described in Alternative C. This alternative, like Alternative C, would not require transportation corridors for the placement or roads, utility lines and pipelines. Existing disturbances would be used as much as possible.

New roads would remain open or closed at the surface owner's discretion. Roads would be reclaimed upon abandonment.

There would be no degradation of watersheds from release of production water. A Water Management Plan would be required for every exploration Permit to Drill. First priority for discharged water would be for beneficial uses.

The potential for fire hazard is the same as Alternatives B, C and D. Surface disturbances associated with Alternative E would impact approximately 44,000 acres long term (Table 4-56). This is equivalent to less than one percent of the Planning Area. The total area of cumulative impacts, including surface disturbances from additional activities described previously, is estimated to be 99,370 acres. This total area is less than 1 percent of the entire Planning Area.

Alternative F—High Range Phased CBNG Development

Exploration and Production

The types of impacts from roads, pipelines and utility lines are the same as those described for Alternatives B and D (Table 4-56). Development would likely have less surface land disturbance, decreased road construction and decreased long-term use due to the following: restrictions on the number of federal permit applications approved annually; consideration of cumulative effects within each 4th Order watershed and crucial habitat polygons during POD development; and the possible discharge of some untreated federal CBNG water to surface water instead of storage or treatment and conveyance. Watershed protection would likely include road obliteration and reclamation to mitigate sensitive wildlife resources, particularly sage-grouse. Thus, this alternative is expected to result in a decrease in open roads and a decrease in road maintenance costs. More roads are expected to be reclaimed under this alternative.

However, over the entire development period, it is expected that the total area disturbed would be most similar to, but slightly less than, Alternatives B and D, including exploration, construction, operation and cumulative effects. Thus, cumulative effects over the entire time period would be similar to Alternatives B, D and F (see Table 4-56). The difference between

Alternative F and Alternatives B and D is primarily the phasing of approved activities rather than the amount and extent of activities. Alternative F would result in a more even level of disturbance activity over the development period. With this phasing, it is likely that slightly less disturbance would occur than Alternatives B and D.

The type of agricultural effects would be similar to Alternative B, although the impacts would be distributed differently over the development period due to phasing of CBNG development.

CBNG activities would continue to increase the likelihood of fire, while road networks created for CBNG development would help to increase access for fighting fires.

Abandonment

Land use displacement from road disturbance is expected to be less considering the extent of displacement in a given year but with a similar total amount as Alternatives B and D over the development period. This is due to a phased development approach of well development and associated road construction, use, operation and maintenance.

Crow Reservation

For development proposed within 5 miles of the Crow Reservation, Alternative F would require the operator to include site-specific groundwater and air quality analyses in the POD to demonstrate no impact to reservation resources. Additionally, groundwater and air quality monitoring may be required during development to ensure that no impacts occur. As a result of this additional level of evaluation, an operator would likely be more cautious regarding its level of disturbance and the tribe would likely have increased opportunity to comment beyond consultation required under all alternatives. Potential mitigation measures reached in agreement with the tribe could include minimizing the amount of surface area disturbance and the extent of new road construction. The tribe could also request increased road abandonment and vegetation restoration following surface disturbance activities, all of which could decrease the overall extent of land disturbance.

Northern Cheyenne Reservation

Land use effects to the Northern Cheyenne Reservation would be similar as described above for the Crow Reservation.

Conclusion

Although the potential amount of surface and road disturbance for Alternative F is similar to Alternatives B and D, surface area disturbance and road construction associated with federal CBNG development would occur in different amounts and within different areas over the development period based on the phasing and watershed-level limitations that are part of this alternative.

With the potential to limit land disturbance and road construction based on watershed-level analysis, the presence of sensitive wildlife habitat and/or the location of development on or adjacent to Northern Cheyenne and Crow reservation lands, this alternative has the potential to have less land use impacts than Alternatives B, C, D and E. However, disturbance to specific areas over the development period is difficult to predict due to the decision to continue to reevaluate development in each watershed over the planning development period and the adaptive management approach that would be used to determine future location and extent of CBNG development.

Alternative G—Low Range Phased CBNG Development

Exploration and Production

The extent of impacts from roads, pipelines and utility lines would be about 65 percent less than Alternative F (Table 4-56). Effects would be phased over time and would have less surface land disturbance and decreased road construction and long-term use than the other development alternatives. Watershed protection would likely include road obliteration and reclamation in the interest of mitigating sensitive wildlife resources, particularly sage-grouse, which is sensitive to human disturbance. Thus, this alternative is expected to result in the lowest open road mileage and least road maintenance costs among all action alternatives. The maximum amount of open roads is expected to be reclaimed under this alternative.

Over the entire development period, it is expected that Alternative G would result in greater land disturbance than Alternative A (no action) but less land disturbance than the other development alternatives (Alternatives B, C, D, E, F and H).

The type of agricultural effects would be similar to Alternative B, although the impacts would be distributed differently over the development period due to phasing of development.

CBNG activities would continue to increase the likelihood of fire, while road networks created for CBNG development would help to increase access for fighting fires.

Abandonment

Land use displacement from road disturbance is expected to be the least amount in any given year and over the development period compared to the other action alternatives. This is due to the lowest number of new wells planned for construction, operation and maintenance, which would result in the lowest amount of road mileage.

Crow Reservation

Similar to Alternative F, Alternative G would have the least effect on Crow Reservation lands because this alternative would also require consultation with the Crow Tribe to minimize overall CBNG development effects. Mitigation measures reached in agreement with the Crow Tribe could include minimizing the amount of surface area disturbed and the extent of new road construction. The Crow Tribe could also request increased road abandonment and vegetation restoration following surface disturbance activities, all of which could decrease the overall extent of land disturbance.

Northern Cheyenne Reservation

Impacts on Northern Cheyenne tribal lands would be similar to that described under the Crow Reservation.

Conclusion

Alternative G would result in the lowest number of new wells and the least amount of total disturbed acres among the development alternatives. Other development effects of Alternative G would be similar to Alternative F since both alternatives would use a phased development approach.

Similar to Alternative F, Alternative G would limit land disturbance and road construction based on a watershed-level analysis, the presence of sensitive wildlife habitat and/or the location of development on or adjacent to Northern Cheyenne and Crow reservation lands. However, disturbance to specific areas over the development period is difficult to predict due to the decision to continue to reevaluate development in each watershed over the development period and the adaptive management approach that would be used to determine future locations and extents of CBNG development.

Alternative H—Preferred Alternative - Multiple Screens

Exploration and Production

The types of impacts from roads, pipelines and utility lines are the same as those described for Alternatives B, D and F (Table 4-56). Development would likely have less surface land disturbance and decreased road construction and long-term use through the use of four resource screens. Similar to Alternative F, mitigation would likely include road obliteration and reclamation in the interest of mitigating sensitive wildlife resources, particularly sage-grouse, as well as water and air resources. Additionally, long-term stakeholder planning within watersheds would likely result in consolidation of infrastructure through coordination and sharing between stakeholders. Thus, this alternative is expected to result in a similar level of open and closed roads, as well as decreased road maintenance costs as Alternative F.

Over the entire development period, it is expected that the total area disturbed would be most similar to Alternative F, including exploration, construction, operation and cumulative effects. The difference between Alternative H and Alternative F is how sensitive resources would be treated (water, wildlife and air), although cumulative land use effects are expected to be similar. Although Alternative H does not include an annual limit on APDs, the rate of development is expected to be similar to Alternative F due to the level of planning and environmental review necessary to address the four resource screens.

The type of agricultural effects would be similar to Alternatives B and F, although the impacts would be distributed over the development period more like Alternative F due to application of the four resource screens to proposed CBNG development.

CBNG activities would continue to increase the likelihood of fire, while road networks created for CBNG development would help to increase access for fighting fires.

Abandonment

Land use displacement from road disturbance is expected to be less, considering the extent of displacement in a given year, but with a similar total amount as Alternatives B, D and F over the development period. This is due to the level of planning necessary to address the four resource screens for proposed well development and associated road construction, use, operation and maintenance.

Crow Reservation

Alternative H includes a Native American Concerns screen, which would likely result in less impacts to the Crow Reservation and its resources than Alternatives B through F. For any POD submitted proposing activities within 5 miles of the reservation, Alternative H would require the operator to demonstrate in the POD that no impacts would occur to reservation resources, as well as monitoring during operations to ensure that no impacts occur (similar to Alternative F). Additionally, operators would be required to consult with affected tribes when proposing development in the vicinity of traditional cultural properties. Consequently, an operator would likely be more cautious on its level of disturbance and the tribe would likely have an increased opportunity to comment, although consultation with the tribe would occur under all alternatives. Potential mitigation measures reached in agreement with the tribe could include minimizing the amount of surface area disturbance and the extent of new road construction. The tribe could also request increased road abandonment and vegetation restoration following surface disturbance activities, all of which could decrease the overall extent of land disturbance.

Northern Cheyenne Reservation

Land use effects to the Northern Cheyenne Reservation would be similar as described above for the Crow Reservation.

Conclusion

The potential amount of surface and road disturbance for Alternative H is similar to Alternatives B, D and F. For alternative H, surface area disturbance and road construction associated with federal CBNG development would occur in different amounts and within different areas over the development period based on the resource screens and watershed-level analysis that are part of this alternative.

This alternative has the potential to have less land use impacts than Alternatives B, C, D and E, but similar effects as Alternative F. Alternative H has the potential to limit land disturbance and road construction based on a screening level analysis for air and water, the presence of sensitive wildlife habitat and/or the location of development on or adjacent to Northern Cheyenne and Crow reservation lands and traditional cultural properties, However, disturbance to specific areas over the development period is difficult to predict due to the decision to continue to reevaluate development in each watershed over the planning development period and the adaptive management approach that would be used to determine future location and extent of CBNG development.

Livestock Grazing

Livestock Grazing *AUM is equal to the amount of forage required to support one cow and her calf or 5 sheep for one month.* *Within the FSEIS Planning Area, BLM-administered surfaces have an estimated 1,389,908 acres of land classified as grazing, capable of supporting 259,554 AUMs.*
Alternative A **No Action (Existing CBNG Management)**
• Exploration wells located within BLM-permitted rangelands would result in the temporary loss of 69 AUMs • State: – The exploration wells and production wells located at CX Ranch would result in a maximum construction loss of 272 AUMs on state and private rangelands.
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• Exploration wells would result in the temporary loss of 413 AUMs (BLM 163, State 250). • Production wells would result in a maximum construction loss of 11,960 AUMs (BLM 4,770, State 7,190).
Alternative C **Emphasize CBNG Development**
• Impacts to livestock grazing would be similar to but slightly greater than those in Alternative B due to the discharge of untreated production water on to the ground resulting in increased erosion • CBNG discharge water could be used for livestock watering. • Increased erosion could result in increased surface disturbance, which could lead to disrupted grazing patterns, undermined fencing and reduced forage. • A decrease in forage could occur if discharged produced water is too high in saline content; and possible effects to livestock if produced water is to unsuitable quality for stock watering.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• Impacts would be similar to Alternative B with some exceptions: disturbed acreage would increase due to the piping of discharge water to the nearest disposal point. There would be less forage losses than Alternative B.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• Impacts to livestock grazing would be similar to Alternative B. • Suitable CBNG discharge water could be used for livestock watering. • Managed irrigation of produced water would promote growth of vegetation.
Alternative F **Phased Development Multiple Screens (High Range)**
• Impacts to livestock grazing would be similar to Alternative B and phased in after watershed analysis. • Water Management Plans for federal CBNG wells would incorporate results and requirements identified by watershed-level analysis • Impacts from federal CBNG development would occur primarily in the latter years of the planning period, generally following after state and private development.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to Alternative F but the land disturbance area would be 65 percent less.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts to livestock grazing would be similar to Alternative B. • CBNG PODs would be screened for four resources, of which water management would have the most potential effects on livestock grazing. • Water Management Plans for federal CBNG wells would incorporate results and requirements identified by watershed-level analysis.

Livestock grazing and petroleum development would be generally compatible because exploration activity would be temporary and operational activities require a small area for equipment. Livestock grazing on rangeland would continue during CBNG and conventional oil and gas development.

Assumptions

Affected acres and animal unit months (AUMs) were calculated assuming all CBNG activity would be located on grazing lands. AUM losses were predicted separately for the two BLM RMPs and the state because of differences in permits and land grazing capacities. The analysis is focused on the Planning Area, but applies to similar areas throughout Montana. It is assumed that existing roads and fence crossings would be used for oil and gas operations as much as possible.

Impacts from Management Common to All Alternatives

Impacts on rangeland would occur from the loss of vegetation for livestock grazing; the disruption to livestock management practices; and loss of grazing capacity from construction of well pads and roads. Each well would present its own set of unique circumstances that would be mitigated to minimize impacts. With the exception of minimal short-term

forage loss, these impacts would only last as long as construction activities were ongoing. Controlling livestock movement by maintaining fence line integrity would be used to preserve efficient livestock and range management. The construction of roads and pipelines would bisect fences, which would require placement and maintenance of cattleguards and gates. The current development of oil and gas and CBNG on state land would require installation of cattleguards on fence lines to prevent livestock escape. The impacts of oil and gas development would result in the loss of about 833 AUMs on BLM-Administered surface in the Billings RMP, 830 AUMs in the Powder River RMP and 359 AUMs on state-permitted rangelands. These losses would be reduced to a total of 735 AUMs during the production phase of oil and gas activities.

While roads, trails and well pads would block traditional cattle trails, this network of new roads would provide livestock producers with improved access to remote livestock facilities and grazing areas. However, road systems would interfere with livestock dispersal and cause decreased forage efficiency because cattle tend to congregate and travel along roads. The relatively high volumes of exploration vehicle traffic would present a hazard to livestock. Heavy traffic on temporary access roads would increase the risk of collision with stock, resulting in injury or death of the animals. Airborne dust stirred up by heavy exploration vehicles would settle on forage along the road. The dust would affect the palatability of grass and forbs up to 1/4 mile from the road. Livestock forage could be killed by accidental spills of crude oil, high saline-produced water, or drilling fluid.

Areas of soil disturbance, such as results from construction, may experience an influx of noxious weeds. Noxious weeds reduce rangeland value to livestock by displacing preferred forage species. Severe infestations would result if weeds are not controlled, decreasing rangeland capacity for grazing. Additionally, some weed species are poisonous to livestock, causing illness, internal injury, or death when ingested.

Loss of AUMs may be reduced somewhat through the beneficial use of produced water, primarily in poorly watered pastures and secondary rangelands. Also, there may be opportunities for surface owners upon well abandonment, to take ownership of CBNG wells and power sources for livestock watering purposes.

Activities other than those associated with CBNG production are expected to result in additional disturbances to livestock grazing. These activities include conventional oil and gas, active coal mines, fires, highway projects, power plants and the proposed Tongue River Railroad. The proposed Tongue River Railroad would extend between 17.3 and 29.4 miles, traversing grazing lands bordering the valley bottom land. The ROW would include between 447 and 636 acres, most of which is agricultural rangeland (411 to 599 acres). The entire ROW would be fenced to keep domestic livestock off the tracks and livestock passes would be installed to allow continued movement between pastures. However local ranchers are concerned livestock may be reluctant to use the passes, especially those used infrequently and this may increase the time required to herd livestock between pastures. Operations may also increase the potential for railroad-caused range fires (Surface Transportation Board 2004).

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Exploration wells located on BLM-permitted rangelands would result in the temporary loss of 30 AUMs for the Billings RMP rangeland and 39 AUMs for the Powder River RMP rangeland. There would be no production activities in BLM planning areas under this alternative and, therefore, no impacts from production. State-permitted exploration and production wells located at CX Ranch would result in a loss of 272 AUMs. Revegetating parts of the well pads during production would reduce the losses to 194 AUMs.

Crow Reservation

Impacts on the Crow Reservation would be the same as described in general for Alternative A. If there were no CBNG development on tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBNG development on the reservation, then reductions in AUMs could occur.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation.

Conclusion

During the next 20 years, disturbances from CBNG development, conventional oil and gas development and other projects considered under the cumulative effects analysis would result in the loss of about 863 AUMs in the Billings RMP, 869 AUMs in the Powder River RMP and 631 AUMs on state-permitted and private rangelands. These losses would be reduced

to a total of 929 AUMs during the production phase of CBNG and conventional oil and gas activities. After CBNG production ceases, the lands would be reclaimed. Revegetated areas would be available for livestock grazing.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Alternative B considers expanded development of CBNG resources. Table 4-57 presents the predicted AUMs that would be lost from exploration, construction and production on both BLM and state grazing lands. Losses from exploration would be mostly temporary (less than 5 years) and would be reclaimed after exploration activities cease. Revegetating parts of the well pads during production would be used to reduce construction losses to those shown below under operation losses.

Impacts on livestock grazing would be reduced under this alternative through the requirement of transportation corridors, using multiple completions per well bore and directional drilling, injecting produced water instead of storing on-site in impoundments and rehabilitating new roads at the end of the well lifetime. All of these would help to minimize the area of surface disturbances shown in Table 4-57 by up to 35 percent during construction and 40 percent during production, thus reducing the number of AUMs lost.

Crow Reservation

If there were no CBNG development on tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBNG development on the reservation, then reductions in AUMs would occur.

Northern Cheyenne Reservation

If there were no CBNG development on tribal Lands, then there are expected to be minimal, if any, impacts on livestock grazing on the reservation. If there is CBNG development on the reservation, then reductions in AUMs would occur.

Conclusion

During the next 20 years, disturbances from CBNG development on state, BLM, Native American and USFS lands; along with the cumulative effects of other projects would result in the loss of about 18,500 AUMs. These AUM losses would be partially recovered during the production phase of CBNG and oil and gas activities and after production ceases and the lands are reclaimed. The requirement for transportation corridors, injection of produced water (less land needed for impoundments) and multiple use of drilling pads would help to minimize livestock grazing losses up to 35 or 40 percent.

Alternative C—Emphasize CBNG Development

Impacts on livestock grazing would be similar to Alternative B with the following exceptions: transportation corridors and collocation of wells would not be required, thereby increasing the number of disturbed acres and AUMs lost compared to Alternative B (see Table 4-57); suitable CBNG discharge water could be used for livestock watering reducing the amount discharged; and the discharge of produced water to the surface would increase erosion and cause increased surface disturbance to livestock. Other impacts would include the possibility of an increase of noxious weeds and a decrease in forage material if produced water that is too high in saline content is discharged on the land surface and possible health effects if livestock consume produced water that is unacceptable (ALL 2001b).

TABLE 4-57

NUMBER OF PREDICTED ANIMAL UNIT MONTHS (AUMS) LOST TO EXPLORATION, CONSTRUCTION AND PRODUCTION FOR ALTERNATIVE B

	AUMs Lost to Exploration	AUMs Lost to Construction	AUMs Lost to Operation
Billings RMP	11	340	209
Powder River RMP	152	4,430	2,275
BLM Sub-total	163	4,770	2,484
State/Private Lands	250	7,190	4,420
Total	413	11,960	6,904

Generally, water is acceptable for livestock if the TDS is lower than 10,000 mg/l and the EC is less than 16,000 µS/cm. Some CBNG water has also been found to exceed standards for fluoride (2 mg/l) and aluminum (0.2 mg/l) (ALL 2001b). Discharging untreated CBNG-produced water on the ground surface at the well pad would lead to increased localized soil erosion and gullying, which could also lead to disrupted grazing patterns, undermined fencing and reduced forage.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices. The discharge of untreated CBNG production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies, fence post disturbance and limited vegetation loss.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices. The discharge of untreated CBNG production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies, fence post disturbance and limited vegetation loss.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance could be greater since transportation corridors and collocated wells are not required. Surface discharge of untreated produced water could result in increased forage loss, erosion, gullying, grazing pattern disruptions and fencing undermining. Forage losses could be permanent because of soil sterilization by saline water applications. This amount would vary depending on the quality and quantity of water discharged. Watering livestock represents only a small portion of the estimated 20 percent beneficial reuse assumed under this alternative, but would still result in a small amount of impacts reduction to the other resources.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts on livestock grazing would be similar to Alternative C with the following exceptions: impacts from drilling and collocation of wells would be the same as Alternative B; transportation corridor and road impacts would be similar to Alternative B; discharged CBNG-produced water would be treated and not discharged directly at the well site; and there would be a reduction to forage losses from increased managed irrigation of produced water through irrigation applications. This would be a favorable impact from having more treated water available in the winter and arid months available for livestock watering and irrigation of grazing lands. Mitigation measures would be similar to Alternative B.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Conclusion

Cumulative impacts would be similar to Alternative C with some exceptions: impacts from drilling and co-location of wells would be the same as Alternative B; transportation corridor and road impacts would be similar to Alternative B; there would be a reduction to forage losses from increased managed irrigation of produced water; and there would be less soil and forage loss from erosion of soils.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Impacts on livestock grazing would be similar to Alternative B with the following exceptions: transportation corridors and co-location of wells would not be required, thereby increasing the number of disturbed acres and AUMs lost compared to Alternative B (see Table 4-57); suitable CBNG discharge water could be used for livestock watering reducing the amount discharged; Water Management Plans would be designed on a site-specific basis so no

degradation would occur to water quality or to beneficial use. Such uses could include livestock watering and irrigation (benefits for livestock). Mitigation measures would be similar to Alternative B.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance could be greater since transportation corridors and co-located wells are not required. There would be less soil and forage loss from erosion of soils. Beneficial use of produced water by watering livestock would reduce, by a small amount, the impacts to other resources.

Alternative F—Phased Development Multiple Screens (High Range)

Impacts on livestock grazing would be similar to Alternative B with the following exceptions: surface disturbance would be less since transportation corridors would not be utilized fully (but subject to watershed-level analysis), CBNG-produced water would be managed on a watershed basis and site-specific Water Management Plans would be designed so that no degradation would occur to water quality or to beneficial uses, such as livestock water; and CBNG production on BLM-administered surfaces would be limited on an annual and watershed basis, resulting in impacts being distributed differently over time and among watersheds. Development of federal CBNG wells would occur primarily in the latter years of the planning period, generally following state and private development, but subject to annual and watershed-specific development limits.

Crow Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Northern Cheyenne Reservation

Off-reservation development will not affect on-Reservation livestock grazing practices.

Conclusion

Cumulative impacts would be similar to Alternative B with some exceptions. The surface disturbance potentially could be less since use of existing transportation corridors or less new road construction may be required as a result of watershed-level analysis. Water Management Plans for federal CBNG wells would incorporate results and requirements identified by watershed-level analysis, thereby potentially increasing beneficial uses of discharge water, which could include livestock watering. Impacts from federal CBNG development would occur primarily in the latter years of the planning period, generally following after state and private development, but subject to annual and watershed-specific limits.

Alternative G—Phased Development Multiple Screens (Low Range)

The extent of land disturbance from roads, pipelines and utility lines would be about 65 percent less than Alternative F. Effects to livestock grazing would likely be similarly less than Alternative F overall but would vary by watershed. Effects would be phased over time and would have less surface land disturbance and decreased road construction and long-term use than the other action alternatives. Thus, Alternative G is expected to result in the least effect on livestock grazing of the action alternatives over the entire planning period.

Crow Reservation

Impacts on Crow Reservation lands would be similar to those described for Alternatives B, D and F.

Northern Cheyenne Reservation

Similar to Alternative F, Alternative G would have the least effect on livestock grazing on Northern Cheyenne Reservation lands.

Conclusion

The cumulative effects of Alternative G would result in the lowest number of new wells and the least amount of total disturbed acres among the action alternatives. Other development effects of Alternative G would be similar to Alternative F since both alternatives would result in a phased development approach based on watershed analysis.

Disturbance to specific areas over the 20-year planning period is difficult to predict, because the alternative would reevaluate development in each watershed over the planning period by using an adaptive management approach to determine future location and extent of CBNG development.

Alternative H—Preferred Alternative - Multiple Screens

Alternative H is similar to Alternatives B and F, although four resource screens would be used to evaluate PODs and on-going development, rather than applying specific annual limits on approved APDs. However, the rate of development is assumed to be similar to Alternative F. In addition to applying the resource screens and watershed-level analysis, operators would be required to follow standard operating procedures for all CBNG development projects. Each POD would be developed in consultation with affected tribes, affected surface owner(s), permittees or lessees and other involved permitting agencies. BMPs would also be used in CBNG development.

As a result of the management actions stipulated for this alternative for crucial sage-grouse habitat areas, a lower level of development is anticipated to occur over approximately 93,259 acres. This would reduce the number of lost AUMs from construction and production phases when compared to Alternatives B and F. Overall, the AUMs lost may be reduced by up to 610 during construction and 318 during operation phases. These figures are likely higher than what will occur because some level of development is likely within the crucial sage-grouse habitat areas.

Four resource screens would be used to develop and evaluate PODs: water resources, wildlife, Native American concerns and air resources. The water screen could affect livestock grazing by altering the surface water quality of available stock water. Impacts on livestock grazing would be similar to Alternative F, but Alternative H would have the benefit of additional water protection. Surface disturbance would be reduced by limiting transportation corridors through watershed-level analysis. CBNG-produced water would be managed on a watershed basis and site-specific Water Management Plans would be designed to prevent degradation of water quality or beneficial uses, such as livestock water.

For each Water Management Plan, the BLM would establish a threshold for the volume of untreated water that could be discharged to surface waters from federal CBNG wells. These requirements would be in addition to the surface water quality and discharge volume limitations which are a part of the MPDES discharge permitting process.

If surface water monitoring indicates a water quality threshold would be exceeded, no further untreated discharge would be allowed from federal wells upstream from the monitoring station. Previously approved water management plans could be modified or rescinded if monitoring indicates unacceptable impacts are occurring. Water quality thresholds and surface water monitoring requirements are detailed in the Hydrology Appendix.

Produced water management plans and permits would be approved by BLM or the appropriate agency in consultation with affected surface owners. Surface storage of produced waters would also require an MPDES permit issued by MDEQ. Impoundments proposed as part of a Water Management Plan would be designed and located to minimize or mitigate impacts on soil, water, vegetation and channel stability. The WMP would also include designs to minimize or mitigate impacts to the available grazing forage. Additionally, such impoundments may be sources of water for uses benefiting livestock, such as livestock watering or surface irrigation.

Crow Reservation

The Crow Tribe considers groundwater a critical resource to their tribal health and welfare. Groundwater is used on the reservation for stock watering and drinking water supplies. In response to these concerns, the BLM would require federal lease operators to protect groundwater from loss or degradation. For all proposed CBNG development within 5 miles of the Crow Reservation, the BLM would require site-specific groundwater analyses to demonstrate its protection as part of the operator's POD. If the analysis indicates impairment to groundwater would occur, the BLM would not approve the APDs. BLM may require an operator to install groundwater monitoring wells between its development area and the reservation to confirm findings of the initial analysis. Protection of reservation groundwater resources would prevent potential impacts to groundwater available for stock watering. Also, development near reservations may provide an additional source of water for beneficial uses on the reservation.

Northern Cheyenne Reservation

The effects to livestock grazing on the Northern Cheyenne Reservation would be the same as those for the Crow Reservation.

Conclusion

Cumulative impacts would be similar to Alternatives B and F. Water Management Plans for federal CBNG wells would incorporate results and requirements identified by watershed-level analysis and the water resource screen, thereby potentially increasing beneficial uses of discharge water, which could include livestock water.

Paleontological Resources

Paleontological Resources *Paleontological resources consist of fossil-bearing rock formations that underlie the entire Planning Area. Fossil outcrops are relatively rare throughout the emphasis area, but know areas are protected.*
Alternative A **No Action (Existing CBNG Management)**
• It is unlikely that any of the 1,500 acres disturbed during CBNG development activities would contain noteworthy paleontological resources. The 575-acre Bridger Fossil Area of Critical Environmental Concern (ACEC) (only paleontological resource) would not be disturbed.
Alternatives B, C, D, E and F
• Impacts would be nearly the same based on level of disturbance, known locations of rich fossil areas and distribution of geological formations with paleontological resources. • There would be between 55,400 and 74,000 short term acres disturbed during CBNG development activities increasing the chance of impacts to fossil resources. Cumulative impacts would disturb an additional 33,400 acres increasing the potential for impacts to fossil resources.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to Alternative F with the exception that they would be reduced by approximately 65 percent due to the lower number of APDs that are predicted to be issued. • There would be between 19,400 and 25,900 short term acres disturbed during CBNG development activities increasing the chance of impacts to fossil resources. Cumulative impacts would disturb an additional 11,700 acres increasing the potential for impacts to fossil resources.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts would be similar to the other expanded development alternatives based on level of disturbance, known locations of rich fossil areas and distribution of geological formations with paleontological resources. However, the consolidated planning for ROWs would result in decreased surface disturbances. • There would be between 55,400 and 74,000 short term acres disturbed during CBNG development activities increasing the chances that a minor fossil discovery would be made. Cumulative impacts would disturb an additional 33,400 acres increasing the likelihood of additional fossil discoveries. Should no drilling occur within crucial sage-grouse habitat areas, the cumulative impacts to paleontological resources will be less than the other alternatives.

Assumptions

Surface occupancy is prohibited within designated paleontological sites on BLM-administered minerals in the Planning Area. A modification or waiver may be applied for as mentioned for the Cultural Resource section. Provided the paleontological resource values can be protected or undesirable impacts mitigated, the exception would be granted.

The collection of vertebrate paleontological remains on BLM-administered surface would be done under a valid paleontological resources use permit and that reasonable, non commercial collections of invertebrate fossils and fossil plants would be allowed under 43 CFR 8365.1. The collection of petrified wood would be allowed under the terms of 43 CFR 3622.

Impacts from Management Common to All Alternatives

Impacts would occur if paleontological resources were encountered unexpectedly during surface disturbance activities.

The construction of the TRR would not disturb any known paleontological resources in the rocks or soils that exist within the alignment ROW. Construction could result in potential impact on currently unknown paleontological resources. Paleontological localities would be identified during detailed pedestrian surveys of the alignment as required in the Surface Transportation Board's programmatic mitigation agreement. If any paleontological resources are located during surveys, mitigation measures would be carried out that include collection and curation of scientifically significant fossils, additional sampling, or monitoring of excavations.

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Impacts from this alternative would be similar to those described in the *Impacts From Management Common to All Alternatives* section above. Other impacts could include vandalism and the illegal removal of fossils by unpermitted fossil collectors resulting from increased accessibility to remote areas.

Crow Reservation

There would not be impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There would not be impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts would include the effects from CBNG development, conventional oil and gas development and surface coal mining activities. Known paleontological resources within the Planning Area would be protected by Section 6 of the lease terms. NSO stipulations applied to known paleontological resources would help protect those sites.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Impacts from Alternative B would be similar to Alternative A, with some exceptions. Development could result in increased access to remote areas. The impacts of increased access could include vandalism or the illegal removal of fossils by unpermitted fossil hunters.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts under this alternative would include increased CBNG development and a potential increase in vandalism or the illegal removal of fossils.

With the development of tribal CBNG resources, it is anticipated some reservation sites would be encountered that may contain important paleontological resources. As the tribes develop their own CBNG resources, it is anticipated tribal monitors would oversee all surface disturbing activities and, therefore, all significant paleontological resources would be protected.

Alternative C—Emphasize CBNG Development

Impacts would be similar to Alternative B with some exceptions. Under this alternative, surface disturbances from ROWs would result in impacts on paleontological resources and increased access to remote areas. The impacts of increased access could include increased vandalism and the illegal removal of fossils by unpermitted fossil hunters.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts would be similar to Alternative B with increased surface disturbance from the lack of ROWs, potential vandalism or removal of fossils because of increased access to remote areas.

The use of tribal monitors overseeing surface disturbing activities on the reservations during tribal CBNG development would prevent most impacts from occurring to paleontological resources.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts would be the same as described under Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Impacts would be similar to Alternative C with some exceptions. Under this alternative, the project plan stipulations could decrease the amount of surface disturbance. Directional drilling may be performed

on deeper coal seams and would decrease surface disturbances. The potential for impacts from surface disturbances resulting from the placement of underground utilities would increase impacts to paleontological resources. Where significant paleontological resources are suspected, the operator's plan will include a paleontological component that will address data collection and evaluation methods if paleontological remains are encountered.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts under this alternative would be similar to Alternative C with the exception of the potential for less surface disturbances. The impacts to paleontological resources would be minimized.

The use of tribal monitors overseeing all land disturbing activities on the reservations during tribal CBNG development would prevent most impacts from occurring to paleontological resources.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative, impacts to paleontological resources would be similar to Alternative E with the exception that impacts may be less due to the 5-mile buffer zone for federal development around the Crow and Northern Cheyenne reservation boundaries.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts under this alternative would be similar to Alternative E with the exception of the potential for less surface disturbances due to the 5-mile buffer zone around the Crow and Northern Cheyenne reservation boundaries. The impacts to paleontological resources would be minimized.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, impacts to paleontological resources would be similar to Alternative F with the exception that the potential impacts to paleontological resources would be reduced by approximately 65 percent based on the fewer number of APDs that are predicted to be issued. Under Alternative G, the annual cumulative limit placed on federal APDs approved by BLM would be set at five percent (323 APDs) of the low-range number of state, private and federal CBNG APDs (6,470) predicted to be approved in the RMP areas (as identified in the Reasonably Foreseeable Development scenario in the 2003 FEIS)

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

Cumulative impacts under this alternative would be similar to Alternative F with the exception that the potential impacts to paleontological resources would be reduced by approximately 65 percent.

Alternative H—Preferred Alternative - Multiple Screens

Under this alternative, approximately 320,000 acres could be surveyed during POD development as part of the cultural resource survey efforts. This surveying would enhance the likelihood that paleontological sites would be identified as part of the CBNG location and placement effort. Impacts to paleontological resources would be minimized but resemble those described for Alternative E.

The use of directional drilling may be performed on deeper coal seams and would decrease surface disturbances. The potential for impacts from surface disturbances resulting from the placement of underground utilities may increase impacts to paleontological resources. However under this alternative, surface disturbances from ROWs would be consolidated to reduce the amount of disturbance and minimize the footprint. This consolidated development would also reduce the amount of roads and marginally increase access to remote areas. The impacts from increased access could include vandalism and the illegal removal of fossils by unpermitted fossil hunters. The need for paleontological inventories would be determined using the Potential Fossil Yield Classification System outlined in BLM Instruction Memorandum 2008-2009.

Where significant paleontological resources are suspected, the operator's plan will include a paleontological component that will address data collection and evaluation methods if paleontological remains are encountered.

Crow Reservation

There are no anticipated impacts to paleontological resources on the Crow Reservation from off-reservation CBNG development.

Northern Cheyenne Reservation

There are no anticipated impacts to paleontological resources on the Northern Cheyenne Reservation from off-reservation CBNG development.

Conclusion

The degree of cumulative impacts under this alternative would be similar to those described for Alternative F with the exception of the potential for less surface disturbances due to the consolidated development planning. The impacts to paleontological resources would be minimized.

Recreation

Recreation *Montana's natural features offer a variety of year-round recreational opportunities*
Alternative A **No Action (Existing CBNG Management)**
• Minor loss of land for recreation purposes and the disruption to recreation activities • Exploratory activities such as drilling and testing could temporarily displace game species locally
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• Moderate loss of land for recreation purposes and the disruption to recreational activities • Increased opportunities for access to remote areas
Alternative C **Emphasize CBNG Development**
• Impacts would be similar to Alternative B with the exception that increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• Impacts would be similar to Alternative B.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• Impacts would be similar to Alternative B.
Alternative F **Phased Development Multiple Screens (High Range)**
• Impacts would be similar to Alternative E. • Impacts from federal CBNG development would occur differently than the other alternatives based on annual and watershed-based limits.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to Alternative F in the sequence of development but would result in lower impacts than the other alternatives.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts would be similar to or less than Alternative F in the sequence of development, but could result in lower visual impacts than the other alternatives due to the use of resource screens and mitigation and management plans for development.

Assumptions

Recreation uses and areas are described in Chapter 3. Most of the recreation resources in the study area consist of dispersed activities such as hunting and fishing. BLM stipulations would be applied. Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. In general, the demand for recreational activities would increase proportionately with the increase or decline of regional populations.

Impacts from Management Common to All Alternatives

Recreation areas are potentially impacted by surface-disturbing activities. The activities that involve the use of heavy equipment (road construction, well drilling, pad construction, pipeline and utility placement, etc.) would result in changes to the natural landscape, which would cause the most surface disturbance and have the greatest impact on recreation areas. Other activities, such as increased travel and vandalism resulting from access improvements and increased erosion from surface disturbances, can also impact recreation areas. These activities can produce indirect impacts to recreation areas such as fires, hazardous waste spills and cleanups, changes in livestock grazing patterns and changes in wildlife habitats.

BLM has stipulations to protect developed recreation areas and undeveloped recreation areas receiving concentrated public use The state also has stipulations for protection of recreation areas including prohibiting activity within 100 feet of streams, ponds, lakes, or other water facilities. Additional state stipulations include a 1/8-mile buffer for rivers, lakes, or reservoirs and a sensitive areas stipulation that may be used when field staff receive comments regarding recreation areas. Most of the recreation resources in the study area are dispersed activities, such as hunting and fishing and are not developed recreation sites. Exploratory activities such as drilling and testing would temporarily displace game species locally. Installation of oil and gas production facilities in areas used for hunting, hiking and other dispersed recreational activities would infringe on the solitude and rural characteristics of the area. The oil and gas infrastructure and activities would reduce the number of game animals in the area or force some game animals to leave the area which would reduce or eliminate certain hunting activities. Hunters would be concerned about shooting around facilities and equipment.

Exploration and production would create new roads that would provide easier motorized access to areas that may not have been accessible before. Motorized recreation user groups would see this as a benefit to their sports and would appreciate increased access to streams, lakes and hunting areas. Non-motorized recreational enthusiasts who seek solitude and quiet, including backpackers, hikers and some hunters and anglers, would not benefit from road development. As formerly remote areas become more accessible and competition for limited resource escalates, conflicts among these user groups would occur.

Increased human access and increased human activity associated with exploration and development would result in increased legal and possibly illegal harvest of fish from nearby drainages. Increased legal harvest would be a recreation benefit as fishing opportunities are more accessible to a wider range of people and game regulations are adapted to accommodate the increased fishing pressure. However, if increased illegal harvest causes fish populations to drop below a sustainable level, fishing as a recreational resource could be affected.

Increased access typically causes an increase in vandalism and the need for law enforcement. As recreation in public lands becomes more popular, undeveloped recreation sites would generally require more time and attention and have the potential to become developed sites, if use becomes concentrated to that level. Exploration and production activities may cause some ranches to be closed to hunting access via surface agreements.

While impacts related to human access would likely increase in areas of CBNG development, public access is limited within much of the area, so that such impacts are expected to be small for most of the public. Current development has limited access by the use of locked gates and not granting public access to development areas.

Effects on recreation from the proposed Tongue River Railroad would vary, depending on the alignment constructed. The Original Preferred Alignment ROW would run through the Tongue River Reservoir State Park and the second-home subdivision of Cormorant Estates and affect access to the park and reservoir shoreline. The Western Alignment would be located between one and two miles from public camping areas at the state park, but the line would be constructed in cuts through most of this area to provide both a visual barrier and sound buffer from the camping areas. This alignment would avoid Cormorant Estates. The Four Mile Creek Alternative would also avoid Cormorant Estates and be located farther from the state park (STB 2004).

Recreational fishing opportunities are available at public access points along the Tongue River, although access for much of the river is controlled by private landowners. During construction, the quality of recreational fishing may be affected by additional turbidity or modified fish behavior. Access to the river may also be impaired in those areas where the railroad is between the river and the Tongue River Road (STB 2004).

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Construction of roads, well pads and facility sites in designated recreation areas or immediately adjacent to them would detract from the quality of the recreation areas and diminish the quality of the recreational experience. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally. Since there would be no production activities in BLM planning areas under this alternative, there would not be direct impacts from production occurring on BLM-administered surface.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for recreation in general. If there were no CBNG development on tribal Lands, then there would be minimal impacts on recreation on the reservation. Impacts to hunting and fishing from trespassing could impact Native Americans who rely on these resources for subsistence purposes.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusion

Cumulative impacts would include the effects of Alternative A combined with conventional oil and gas development and other projects discussed in the Minerals Appendix. These would include impacts from nearby activities such as mining or power generation facilities, which can result in increased use due to increases in population associated with additional available jobs. (Note: surface mining is

preparing to expand by 4,000 acres under permit request now. See this chapter's *Introduction* section.)

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Alternative B would allow development with single-lane roads and turnouts. Upon abandonment, new roads would be rehabilitated and closed. Impacts from this alternative would be similar to Alternative A with the addition of increased CBNG development resulting in increased access, resulting in increased impacts on dispersed recreation activities such as hunting and fishing.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Conclusion

The residual impact of this alternative is increased CBNG development, which could result in increased access to remote areas and increased vandalism.

Cumulative impacts under this alternative would be greater than those described under Alternative A.

Alternative C—Emphasize CBNG Development

Impacts on recreation areas would be similar to Alternative B, but an increased number of disturbed acres and opportunities for access. Discharge of produced water directly to the ground could increase erosion. Increased erosion could lead to a reduced amount of land available for recreation activities and could disrupt habitat for game species.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting. The discharge of untreated CBNG production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies and limited vegetation loss that could further alter wildlife habitat and change hunting opportunities.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting. The discharge of untreated CBNG production water on ground surfaces within the reservation boundary (from development adjacent to the reservation) could lead to localized soil erosion, which could result in the creation of gullies and limited vegetation loss that could further alter wildlife habitat and change hunting opportunities.

Conclusion

The residual impacts of this alternative are similar to Alternative B. The greater surface disturbance from roads could increase the opportunity for access to remote areas. The discharge of water could increase erosion and damage lands used for recreation.

Cumulative impacts would be greater than those described under Alternative B, but on a large scale because of the emphasis on CBNG development.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts on recreation resources would be similar to Alternative B, but less because of water management measures to eliminate soil erosion by piping discharged water to the nearest body of water.

New oil and gas roads would remain open or closed at the surface owner's discretion. Open roads would create impacts; closed roads would prevent impacts.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Conclusion

The residual impacts of this alternative would be similar to those described under Alternative B. Cumulative impacts would be greater than those described under Alternative A because of the expanded CBNG development.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Alternative E would allow CBNG development subject to existing planning restrictions and balances CBNG development and the protection of the natural environment. Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally. Impacts from surface disturbance would be minimized by using existing disturbances where possible. Because transportation corridors are not required, the number of disturbed acres and opportunities for access would be greater than Alternative B.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife migration patterns, which could affect on-reservation hunting.

Conclusion

The residual impacts of this alternative are similar to Alternative B. Surface disturbance from roads would be greater than Alternative B, increasing the opportunity for access to remote areas.

Cumulative impacts would be similar to those described under Alternative B.

Alternative F—Phased Development Multiple Screens (High Range)

Impacts on recreation areas would be similar to Alternative E, including the loss of land for recreation purposes and disruption of recreation activities. However, surface disturbance from roads and utilities would be similar to or less than those discussed under Alternative B, because transportation and utility corridors may be required based on watershed-level planning. Corridors planned at the watershed-level would require actions to minimize resource impacts from federal CBNG development.

During the first several years of the planning period, the number of disturbed acres and opportunities for access from federal CBNG development would be less than Alternative E, resulting in lower initial impacts to recreation. However, the number of disturbed acres and opportunities for access could be similar to Alternative E during the latter half of the planning period as the predicted annual limits on federal CBNG wells increase.

Recreation impacts under Alternative F could be less than the other alternatives because each proposal for development would be subject to review against the four resource screens (air, water, wildlife and Native American concerns) and planning and mitigation requirements. This review process would balance CBNG development with protection of the natural environment. Recreation is not an individual screen for the POD review process, but is considered in individual analyses. Additionally, key environmental and wildlife resources are subject to the screening process. Protection of these resources would help maintain some wildlife habitat. The anticipated lower level of development intensity in the crucial sage-grouse habitat areas is an example of how wildlife

protection measures may influence impacts to recreation opportunities. Specifically, fewer roads within the sage-grouse habitat areas may reduce access to some lands, which may increase the quality of some hunting opportunities. Conversely, increased road density could aid guides in increasing hunter success rates.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife distribution patterns, which could affect on-reservation hunting.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Fragmentation of wildlife habitat by surface disturbances outside of the reservation may change wildlife distribution patterns, which could affect on-reservation hunting. However, there appears to be little or no seasonal migration of mule deer in southeastern Montana (BLM 1984b).

Conclusion

The residual impacts of this alternative would be similar to Alternative E. Surface disturbance from federal CBNG development would be less than Alternative E and similar to Alternative B because watershed-level analysis would further limit the amount of surface disturbance and the disposal of produced water.

The amount of cumulative impacts would eventually be similar to that expected under Alternative E. Impacts may include the loss of land for recreation purposes, disruption of recreation activities and increased use due to increases in population associated with additional available jobs. These impacts would result from CBNG-related activities under this alternative, as well as other activities existing or proposed within the area, such as conventional oil and gas development, coal mining, power generation plants and the Tongue River Railroad.

Alternative G—Phased Development Multiple Screens (Low Range)

Overall impact to recreation at the end of the 20-year development cycle would be noticeably less than that of the other action alternatives because Alternative G would result in approximately one-third the number of wellheads. Alternative G would be similar to Alternative F in the sequence of development predicted and impacts would accumulate each year as the number of developed wells increases. Since development would be distributed over several watersheds, those with the greatest number of wellheads could experience the greatest impacts from federal CBNG development.

Crow Reservation

Impacts on the Crow Reservation would be similar in nature to those described for Alternative F; however, the amount of impacts would be less than the other action alternatives due to the limited number of wells that would be developed.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Overall impacts of this alternative would be similar in nature to Alternative F. Surface disturbance from federal CBNG development would be less than the other action alternatives due to the limited number of wells that would be developed. Additionally, watershed-level analysis could further limit the amount of surface disturbance and the disposal of produced water. Discharge of produced water directly to surface waters could increase erosion which could lead to a reduced amount of land available for recreation activities or disrupt habitat for game species.

As with Alternative F, short-term construction impacts would be greater than the long-term impacts because the footprint of each operating well is smaller than the necessary construction footprint.

Cumulative impacts would be less than those described under the other action alternatives because fewer total wells would be developed.

Alternative H—Preferred Alternative - Multiple Screens

Overall impacts to recreation would be similar to or less than Alternatives E and F. Based on a rate of development similar to that predicted for Alternative F, impacts from federal CBNG development under Alternative H would be lower during the first few years of the planning period than Alternatives B, C, D and E. Impacts would accumulate each year

thereafter as the number of developed wells increases. Since development is distributed over several watersheds, those with the greatest number of developed wells could experience the greatest impact to recreation activities. The greatest effects due to federal development are predicted to be in the Lower and Upper Tongue, Middle Powder and Rosebud watersheds based on the anticipated resource availability and level of development these areas are anticipated to receive the greatest number of CBNG wells..

Recreation impacts under Alternative H could be less than the other alternatives because each proposal for development would be subject to review against the four resource screens (air, water, wildlife and Native American concerns) and planning and mitigation requirements. This review process would balance CBNG development with protection of the natural environment. Recreation is not an individual screen for the POD review process, but is considered in individual analyses. Additionally, key environmental and wildlife conditions are subject to the screening process. Implementation of these conditions would help maintain wildlife habitat.

Impacts on recreation areas may include the loss of land for recreation purposes and the disruption to recreation activities. Exploratory activities such as drilling and testing would temporarily displace game species locally.

BLM would require a water management plan and use watershed-based thresholds for the volume of untreated water that could be discharged to surface waters from federal CBNG wells. These requirements would be in addition to the surface water quality and discharge volume limitations already included in the MPDES discharge permitting process.

Disturbance to movement of big game species due to new roads could be less than Alternatives E and F because there would be minimal road construction. Transportation corridors (proposed roads, flowline routes and utility line routes) would be located to follow existing routes, or areas of previous surface disturbance, where possible.

Cumulative impacts to water quality and quantity would result within the watersheds as both federal and state/private development occurs. However, Alternative H includes watershed-level analysis as part of POD development and review to evaluate and address cumulative impacts as they are identified.

Crow Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. The Native American concerns screen would provide an additional level of resource protection for development proposed within 5 miles of the reservation and in the vicinity of traditional cultural properties through consultation with the tribe and monitoring during development.

Northern Cheyenne Reservation

Most recreation resources on the reservation will not be affected by off-reservation development. Additionally, the Native American concerns screen would provide an additional level of resource protection for development proposed within 5 miles of the reservation and in the vicinity of traditional cultural properties through consultation with the tribe and monitoring during development.

Conclusion

The residual impacts of this alternative are similar to Alternatives E and F. Development could result in increased access to remote areas and increased vandalism. Short-term construction impacts would be greater than the long-term impacts because the footprint of each operating well is smaller than the necessary construction footprint.

Cumulative impacts would be similar to those described under Alternative B and would result over time and within the watersheds as both federal and state/private CBNG well development occurs. Cumulative impacts would include the effects of CBNG development combined with other existing or proposed activities, such as conventional oil and gas development, coal mining, power generation plants and the Tongue River Railroad. These activities could result in increased use due to increases in population associated with additional available jobs.

Social and Economic Values

Social and Economic Values *Socio-economics address the changes in demographics; social organization, including housing, attitudes and lifestyles; economics, such as employment, unemployment, and per capita income; and government revenue sources, including taxes, state oil and gas lease income, federal mineral revenues and private landowner revenues.*
Alternative A **No Action (Existing CBNG Management)**
• Few social impacts (only small changes in employment, population, demand for services, etc.). • Small impact on economic conditions as a result of new production wells.
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• It is expected that most new CBNG jobs would be filled by CBNG workers commuting from Wyoming. If this occurs, social benefits and impacts could be less than described below. • Social impacts would include new jobs and new population moving to the area. • Economic benefits include generation of new personal and government income. • Additional disposal costs associated with injection of produced water. • Additional demands on public services.
Alternative C **Emphasize CBNG Development**
• Social impacts same as Alternative B. Increase in impacts on lifestyles and values. • Economic impacts same as Alternative B. Increase in impacts to water resource users.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• Social impacts same as Alternative B. Small increase in impacts on lifestyles and values. • Economic impacts same as Alternative B. Small increase in impacts to water resource users.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• Social impacts same as Alternative B. Public burden to maintain roads may increase depending on landowner access decisions. • Economic impacts same as Alternative B, except that oil and gas income may be less depending on water treatment costs.
Alternative F **Phased Development Multiple Screens (High Range)**
• Because development is phased, it is likely that most new CBNG jobs would be filled by CBNG workers commuting from Wyoming. • Social impacts similar to Alternative E and less than Alternatives B through D during certain years, but longer in duration due to phased development. • Economic benefits and impacts lower than Alternatives B through E, but longer in duration due to the evening out of CBNG activities over the phased development period. • The potential for 2,333 fewer wells to be drilled in crucial sage-grouse habitat would have little discernible impact on the number of jobs or duration of the overall project. • Reduction of wells or resource recovery in crucial sage-grouse habitat will reduce the revenues to operators, royalties and taxes paid to the Federal, State and local government, as well as potentially affecting some private mineral estate owners.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Social impacts less than other development alternatives, with duration of impacts similar to Alternative F due to phased development. • Economic benefits and impacts lower than Alternatives B through F, with duration of impacts similar to Alternative F due to phased development.
Alternative H **Preferred Alternative - Multiple Screens**
• Social and economic impacts similar to Alternative F due to similar rate of CBNG well development.

Assumptions

It is assumed that the average CBNG production well in Montana produces about 125,000 cubic feet per day (MBOGC 2001a). Using a gas price of about $4.00 per thousand cubic feet, the average well would generate about $182,500 per year in total income. Income-producing wells on average are expected to last between 10 and 20 years, with an average production life of 15 years. Exploration wells do not produce income.

The social and economic analysis in this chapter is based on the RFD rate of development over a 20-year period for Alternatives A through E and up to a 23-year period for Alternatives F, G and H. During this 20- or 23-year period, all CBNG wells would be drilled and production would peak. However, because CBNG wells typically produce for 10 to 20 years, a well drilled in year 20 would continue to produce until year 40. Thus, social and economic consequences of production and abandonment would continue for up to 20 more years beyond the period assessed here.

The number and type of jobs related to CBNG development would vary with the project phase, exploration, development, production, or abandonment. During exploration and development, the majority of jobs created would be for well drillers and pipeline installers along with specialty positions such as land surveyors, supervisors and geologists. A number of related support personnel (e.g., truck drivers and material handlers) would also be required during these activities. During production, most new jobs would be for maintenance and repair workers and their supervisors. During abandonment, field workers, support workers and their supervisors would be in demand. Average numbers and types of jobs and their associated wages are estimated based on a recent report on the economic impacts of CBNG development in the Powder River Basin (ZurMuehlen 2001), which assumes the following ratios: 49 jobs per 160 wells for exploration/development; 9 jobs per 160 wells for production; and 12 jobs per 160 wells for abandonment.

Based on interviews with CBNG operators currently working in the Planning Area, it is likely that workers from Sheridan, Buffalo and Gillette, Wyoming would fill most of the new jobs related to CBNG and described in the alternatives (Langhus 2006). Most of the CBNG companies and related service companies have offices located in these Wyoming cities while one CBNG company has an office in Billings, Montana and service companies have offices located in Billings, Forsyth and Miles City.

For most of the well sites, CBNG workers would commute on a daily basis from their homes in Wyoming. See Map 4-3 for a depiction of existing CBNG well sites, proposed development areas (based on existing coal deposits) and roads CBNG workers would use to access development areas. The first years of CBNG development would likely be near the Wyoming border and the Tongue River (Big Horn County), just north of Sheridan. In later years, development would likely move east into Powder River County, north of Gillette. The last wells to be developed would likely be those to the north in Rosebud County and in the counties west of the reservations. The number of wells to be developed in the western portion of the Planning Area would be much lower than in the eastern portion. Some workers who would be unwilling to commute would likely share or bring their own camping facilities. Motels may provide temporary housing for CBNG workers.

Recent interviews with operators indicate they would be able to meet the CBNG labor demand for the alternatives within their existing organizations. One reason this will be feasible is that work on each well during each phase of development would be short-term and often part-time. For example, installation of each well would require a crew of 7 to 8 workers over 3 to 5 days for drilling, with an additional 2 to 3 days for completion work. Rather than have multiple crews install many wells at the same time, the same crew would move from site to site installing wells over a longer period of time. The abandonment phase would work in a similar manner. During the operational phase, only a few workers would be needed to monitor wells since, due to automated systems, only short and periodic visits to the wells would be needed. A small number of workers would be needed for water management. Most water treatment technologies are automatically operated and assembled from modular components.

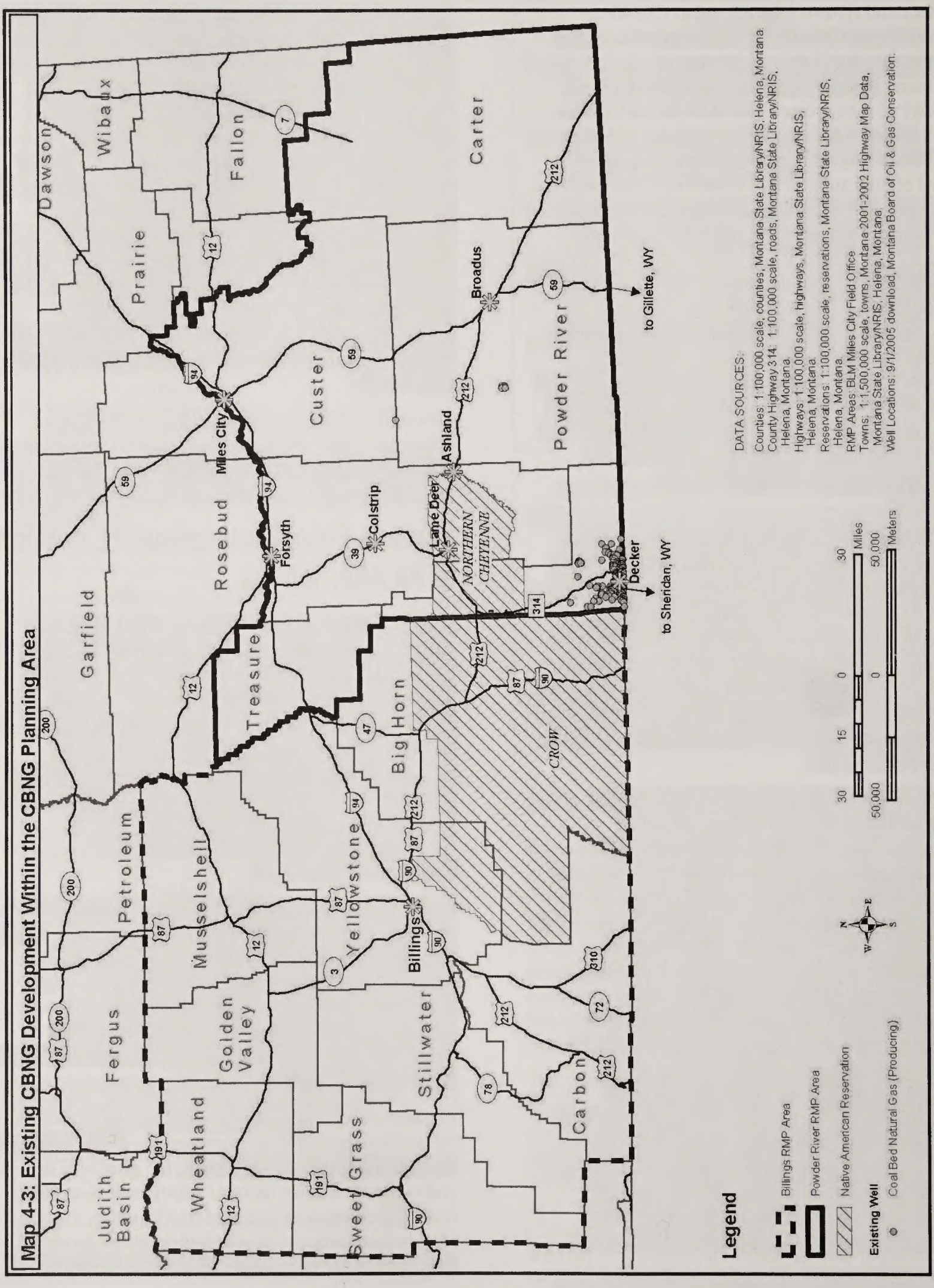
To simplify this analysis, all dollar amounts (e.g., wages and other project-related income) are reported in 2002 dollars, as originally used in the Statewide Document, with no adjustment for inflation over time.

Impacts From Management Common to All Alternatives

Although many jobs are estimated to be created by CBNG development, the socioeconomic impacts of this development would depend to a great extent on how the operators distribute employment. If current CBNG industry employees from Wyoming fill the jobs created by the proposed CBNG development as expected, the economic benefits of the wages earned would mainly go to Wyoming. Some indirect benefits in the Planning Area would be realized due to expenditures near CBNG sites (gas stations, restaurants, stores, etc.).

There are few towns and commercial establishments between Sheridan or Gillette and the Montana CBNG sites where workers would be able to spend their wages or purchase supplies. For that reason, most indirect employment and income from support expenses would occur in Wyoming. Most of the CBNG employees working in Montana commute from Wyoming (BLM 2003).

Impacts on social conditions would include changes in the services provided by governments due to increased funds from CBNG development; the effects of drilling and related activities on rural lifestyles in the project area; and changes in levels of traffic, noise, visual resource impacts and psychological stress levels, as described below. Employment and population would


Map 4-3: Existing CBNG Development Within the CBNG Planning Area
Garfield
Dawson
Wibaux
Prairie
Fallon
Carter
Rosebud
Miles City
Custer
Broadus
Powder River
Forsyth
Colstrip
Lame Deer
Ashland
Decker
NORTHERN CHEYENNE
to Gillette, WY
to Sheridan, WY
Judith Basin
Fergus
Petroleum
Musselshell
Treasure
Yellowstone
Big Horn
Billings
CROW
Wheatland
Golden Valley
Sweet Grass
Stillwater
Carbon
DATA SOURCES:
Counties: 1:100,000 scale, counties, Montana State Library/NRIS, Helena, Montana.
County Highway 314: 1:100,000 scale, roads, Montana State Library/NRIS, Helena, Montana
Highways: 1:100,000 scale, highways, Montana State Library/NRIS, Helena, Montana
Reservations: 1:100,000 scale, reservations, Montana State Library/NRIS, Helena, Montana
RMP Areas: BLM Miles City Field Office
Towns: 1:1,500,000 scale, towns, Montana 2001-2002 Highway Map Data, Montana State Library/NRIS, Helena, Montana
Well Locations: 9/1/2005 download, Montana Board of Oil & Gas Conservation.
30 0 30 Miles
50,000 0 50,000 Meters
Legend
Billings RMP Area
Powder River RMP Area
Native American Reservation
Existing Well
Coal Bed Natural Gas (Producing)

not likely change because CBNG workers would be supplied by the existing workforce in Wyoming. This would limit both the employment opportunities and adverse effects of population change on local housing, schools and services.

The information reflected in the public comments and newspaper reports summarized in Chapter 3 indicate a range of attitudes and beliefs with respect to the development of CBNG and its relationship to the lifestyles and values of area residents.

As discussed in Chapter 3, the majority of public comments received during scoping related to concerns about impacts on the environment and water quality and quantity in particular. The possibility of unfavorable economic impacts resulting from environmental impacts are also a concern. Other concerns include possible increases in traffic levels, noise, visual resource impacts and psychological stress associated with changes to the surrounding built and natural environment.

Numerous social and cultural impacts have been predicted by Native Americans as a result of CBNG development on adjacent private, state and federal minerals. These potential impacts include: the lack of access to energy-related employment, population influx, over-commitment of tribal revenue, abridged effectiveness of tribal governments, stressed infrastructure and service related capacity, altered social organization and social well being perception and the further influence of western culture resulting in changes to traditional beliefs and value systems.

Direct economic impacts of the project would include lease, royalty and production payments; taxes and other government levies; impacts resulting from changes in environmental quality; and related changes in the fiscal health of county, state and federal governments. Changes in personal income resulting from new employment of CBNG workers and purchases of services from vendors are more likely to occur in Wyoming than the Planning Area. Similarly, indirect impacts including induced economic activity from local purchases of equipment, supplies and services and induced economic activity from purchases of goods and services by project workers would also be most likely to occur in Wyoming. The largest economic benefit from CBNG development is the methane itself, measured by the revenues obtained by the companies involved in developing the resource. It is assumed that most of these revenues would go to out-of-state companies. Montana's share of that benefit would come mostly in the form of natural gas taxes and royalties, discussed below.

Conventional oil and gas development would have economic impacts on landowners, communities, county governments, reservations and the state and Federal governments. When hydrocarbons are produced and sold, the operator is responsible for paying the mineral owner and governmental entities in the form of taxes and royalties.

Property values would be affected by full field development. Full-size ranches would be impacted by the increase in activity accompanying development. This could include such factors as the change in rural character of the land. Ranchers choosing to sell their ranches would receive less monetarily if the ranch sells without mineral rights attached. Outfitting would be impacted from the visual intrusion of increased road and CBNG facility development, causing a decline in outfitting income.

Conventional well development is projected at between 595 to 2,325 additional oil and gas wells over the next 20 years. This level of industrial activity (average 116 wells per year) would have negligible impact on the social and economic resources of the area.

It is expected that development will occur first within the southern portion of the Planning Area along the Montana/Wyoming border and then expand to the north and to the east of the CX Field. CBNG workers that come from Sheridan, Buffalo or Gillette, Wyoming to work in the existing CBNG fields and the areas most likely to be developed next in Montana will not travel across the Northern Cheyenne or Crow reservations on their journey to work.

When the wells to the north of the Northern Cheyenne Reservation are developed, CBNG workers may need to drive across the Northern Cheyenne Reservation to reach some of the sites. Although the number of wells predicted in the RFD to be developed north of the Northern Cheyenne Reservation is relatively small, limited traffic, noise, safety and road maintenance impacts on the reservation could occur. The Northern Cheyenne are concerned that this would increase tribal member contact with outsiders, increasing the negative effects of social change described above. However, with any of the alternatives, there would be little reason for CBNG workers to stop on the reservation, because few services are offered on the reservation routes that would be used. Interaction with commuting workers is not expected.

CBNG workers needing to travel from Sheridan or Gillette to the potential CBNG sites in the western part of the Planning Area would likely drive from Sheridan to Lovell, Wyoming or travel north from Powell, Wyoming or travel south from Billings, Montana.

Cumulative effects of coal development in Wyoming, including CBNG development, is discussed in the Task 3C Report for the Powder River Basin Coal Review Cumulative Social and Economic Effects Report (BLM 2005e). The analysis projects employment in the Wyoming Powder River Basin to increase by one-third (more than 2,300 jobs) compared to 2003 levels, with the largest growth occurring by 2010. The increase in employment is expected to increase income to individuals and government agencies in the area, but would also stimulate migration to the area, resulting in shortages in housing and community services. Effects to communities would depend on how well they can absorb the increase in population. Development of CBNG in Montana would increase these cumulative effects because CBNG operators are expecting to use the same workforce in Wyoming to develop CBNG wells in Montana.

If the Tongue River Railroad is built, there would be cumulative socioeconomic effects in areas where the railroad is near CBNG sites. Construction of the railroad would create primary and secondary jobs and promote purchases of equipment and material from local vendors. However, construction labor requirements raise the potential for creating temporary (2- or 3-year) demands on limited local services. The increased taxable revenues would benefit local governments and school districts. Land use effects from construction of the railroad would include permanent acquisition of land for railroad right-of-way and short-term acquisition of land for construction areas. Some parcels would be severed, which could interfere with cattle and wildlife movement and irrigated agriculture. Presence of the railroad through or near recreational home sites could reduce the market value of the individual tracts. Construction of the railroad would increase in vehicle travel on local roads.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

As explained under the *Assumptions* section, most jobs created for CBNG development in Montana would likely be filled by Wyoming CBNG workers. This is true for Alternative A as well. In general, the scenario below lists greater economic benefits and greater social impacts than would likely occur.

Employment and Unemployment

The location and distribution of the exploratory wells by county is not known and therefore, this analysis assumes the wells in the two RMPs are distributed across those areas and the wells to be drilled statewide are also distributed geographically in proportion to the RFD estimates for development. The production wells are assumed to be confined to the CX Ranch in Big Horn County.

Average numbers and types of jobs and their associated wages are estimated based on a recent report on the economic impacts of CBNG development in the Powder River Basin (ZurMuehlen 2001), which assumes the following ratios: 49 jobs per 160 wells for exploration/development; 9 jobs per 160 wells for production; and 12 jobs per 160 wells for abandonment. As shown in Table 4-58, the estimated number of jobs created under Alternative A would range between 175 (Year 1) and 14 (Years 8 through 19), for an average of about 32 jobs per year over the period. This change would be small compared to the total employment in the Planning Area (122,000 in 1998). For Alternative A, it is assumed that all wells would be abandoned by year 20 of the project.

Measurable indirect changes to local employment would not be anticipated for Alternative A. The purchase of equipment, supplies and services related to the proposed wells would have some impact but likely would not be distinguishable from the existing economic activity in the Planning Area and in the state.

Thus, few or no new jobs would be created indirectly. New employment created directly and indirectly for Alternative A would be small in relation to total employment in the Planning Area (122,000 in 1998) and therefore, it would not be expected to result in changes to current county or state unemployment rates.

Demographics

Employees who would fill the CBNG jobs would likely be a mixture of current residents from the surrounding areas and those who would be drawn to the project and its employment opportunities from around the region. It is assumed that local labor (i.e., those within commuting distance of the CBNG well locations) would be used to the extent available; however, many of the new jobs would likely be filled by new migrants to the region. The degree to which the jobs would be filled by current residents would depend on a number of factors, including job skills. The extent

TABLE 4-58

ALTERNATIVE A: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION, AND ABANDONMENT
(WAGES REPORTED IN CONSTANT DOLLARS)[1]

Year	Wells Drilled per Year	Initial Development Jobs	Initial Development Wages[2]	Wells Producing per Year	Production Jobs	Production Wages	Wells Abandoned per Year	Abandonment Jobs	Abandonment Wages	Estimated Total Jobs	Estimated Total Wages
1	525	161	$4,662,656	250	14	$539,063				175	$5,201,719
2	150	46	$1,332,188	250	14	$539,063				60	$1,871,250
3	150	46	$1,332,188	250	14	$539,063				60	$1,871,250
4	100	31	$888,125	250	14	$539,063	375	28	$972,656	73	$2,399,844
5				250	14	$539,063	100	8	$259,375	22	$798,438
6				250	14	$539,063	100	8	$259,375	22	$798,438
7				250	14	$539,063	100	8	$259,375	22	$798,438
8				250	14	$539,063				14	$539,063
9				250	14	$539,063				14	$539,063
10				250	14	$539,063				14	$539,063
11				250	14	$539,063				14	$539,063
12				250	14	$539,063				14	$539,063
13				250	14	$539,063				14	$539,063
14				250	14	$539,063				14	$539,063
15				250	14	$539,063				14	$539,063
16				250	14	$539,063				14	$539,063
17				250	14	$539,063				14	$539,063
18				250	14	$539,063				14	$539,063
19				250	14	$539,063				14	$539,063
20				250	14	$539,063	250	19	$648,438	33	$1,187,500
20-Year Total	**925**	**283**	**$8,215,156**	**250**	**14[3]**	**$10,781,250**	**925**	**69**	**$2,399,219**	**634**	**$21,395,625**

NOTES:

[1]Data for jobs per well and wages (ZurMuehlen 2001).

[2]Wages paid for initial development phase for well drillers and pipeline installers was estimated at $6,600 per well (Langhus 2001)

[3]The same number of jobs are assumed to last for the duration of the planning period.

to which workers who move to the region for new jobs would bring families with them would depend on a number of factors, most notably the duration of the job in a given location. Assuming a mixture of single employees and those with families, it is estimated that, on average, each new employee would bring one additional person to the region. Even if all the jobs (175 during Year 1) were filled by new migrants to the region and resulted in new persons moving to the area, the total new population (perhaps 350 persons) would be small compared to the total regional population (196,000 in 2000). There would likely be some concentration of new residents associated with jobs in Big Horn County related to the CX Ranch. Given that any new population would be spread over both time and geographic area, no change in demographics would be anticipated from Alternative A.

Social Organization

Housing Units and Vacancy

Only small changes in the supply or demand of permanent or temporary housing are anticipated as part of Alternative A. This follows from the small changes in employment and population discussed above. However, there could be short term localized housing shortages depending on the size of the population increase in Big Horn County.

Public Services and Utilities

The relatively small scale of CBNG well development would not result in any substantial changes in the ability of county, state, or Federal governments to provide public services or utilities. The basis for this conclusion is the lack of additional temporary or permanent population and the associated lack of demand for additional public services. However, there could be short term localized increases in public services demands depending on the size of the population increase in Big Horn County.

Attitudes, Beliefs, Lifestyles and Values

The limited development of CBNG proposed for Alternative A likely would be experienced by the communities in the Planning Area as a continuation of existing oil and gas development practices in the region and in the state. As a result, these actions by themselves would likely be perceived as generally consistent with the attitudes, beliefs, lifestyles and values of most population groups (e.g., ranchers, Native Americans, small town residents).

Personal Income

Wages paid to project employees would contribute to the total personal and per capita income of every county where employees reside. As shown in Table 4-58, total direct wages from Alternative A over 20 years are estimated at about $21 million and would range from a high of $5.2 million (Year 1) to a low of $539,000 (Years 8 through 19).

Any of the producing wells proposed for operation on the CX Ranch would generate new personal income, depending on ownership. Individuals who own the mineral rights to their land and lease those rights to developers as part of the existing management scenario would receive additional income from rents or royalties. Although only a small percentage of landowners own mineral rights, the royalty income to any one individual would still be substantial over many years if a given well is highly productive. Individuals on whose land CBNG is developed but who do not own the mineral rights to their land would receive one-time payments as compensation for land disturbance. However, given the small scale of production anticipated, these changes to personal income likely would have only a small effect on the per capita income of the Planning Area or the state as a whole.

Additional personal income for residents of the counties and the state would be generated by circulation and re-circulation of dollars paid out as business expenditures and as state and local taxes.

Government Revenues

The primary source of government revenues generated by the project would be from taxes levied on property, equipment, income and natural gas output generated by production wells. Exploratory wells would generate government income only to the extent the associated temporary facilities are subject to local property taxes.

Oil and Gas Income

Royalties of 12.5 percent are typically earned for oil and gas production on state and federal lands. About 50 percent of royalties paid to the federal government are generally returned to the state from which they originate. Assuming the 250 production wells on the CX Ranch proposed for Alternative A each generate about $182,500 in gross production income per year (assuming production of 125,000 cubic feet per day and a price of $4.00 per thousand cubic feet), the total annual gross income would be about $45.6 million per year for an average of 15 years. About 12.5 percent, or $5.7 million, of this new income would accrue to the state, federal, or private mineral owner annually.

Rents on state and federal lands leased for oil and gas development are bid competitively, with the lowest bid being $1.50 per acre. Resulting government income would depend on the specifics of leases on the CX Ranch; however, it is assumed that additional income would accrue to the state and federal government.

Taxes

Income Taxes

A portion of the taxable income (wages, rent or royalty income and land disturbance payments) generated by Alternative A would accrue to the state as income tax revenue. Income taxes would be paid on the annual wages paid for the average 32 jobs per year discussed under *Employment*. Dividing the estimated total wages over 20 years by the estimated total jobs for the same period (Table 4-58), the average annual salary per job would be about $34,000. Income in Montana is taxed according to a graduated rate structure with rates ranging from 2 percent to 11 percent of taxable income; the average rate in 2000 was about 3 percent (Montana Department of Revenue 2001). It is important to note that these sums are already included in the estimates of personal income (income taxes are a transfer of personal income to the state). Thus, estimated income tax revenues from an annual average of 32 jobs at $34,000 would range from $21,800 (2 percent tax rate) to $119,700 (11 percent tax rate), with a likely amount closer to $32,600 (3 percent tax rate) based on recent history. The project would result in an increase in state tax revenues to the extent that new income is created that didn't previously exist in the state.

Property Taxes

Both real and personal property are subject to property taxes. Personal property would consist of structures, equipment and materials used for the proposed exploration and production of CBNG. Taxes on real property would be based on changes in the assessed value that result from improvements to the property. Each county in which facilities were located would assess tax levies and apply them to the taxable value of the relevant facilities. The levy would be based on the total value of property multiplied by a tax rate or rates specific to the property location (i.e., county and special service districts). Any such additional property taxes would contribute new income directly to both the county tax base and the local economy. It should be noted that property taxes on business equipment (e.g., drilling equipment) would likely be phased out by 2006, reducing the total taxes that would be collected.

Given the limited nature of CBNG exploration and development proposed in Alternative A, changes in taxes are not expected to be substantial for any given county. The exception is Big Horn County, where the new production wells are proposed. Additional county tax revenues would be anticipated. Property tax revenues would be a cost to CBNG development companies and landowners and a benefit to the counties and the state.

Natural Resources Taxes

The products of natural resource extraction in Montana, including natural gas, are subject to state natural resource taxes, including local government severance taxes. Any new production of natural gas generated by the 250 production wells in Big Horn County would be subject to such taxes. Severance taxes are distributed to a variety of state and local funds and would contribute positively to the state and local economies.

Other Taxes

In general, the local and state economies would benefit from sales of goods and services by local businesses to oil and gas operators associated with the project. However, local sales of goods and services associated with CBNG development would not generate increases in tax revenues because there is no sales tax in Montana.

Water Resource Values

The purpose of a discussion of water resource values in the *Economics* section of this report is to acknowledge that the existing surface and groundwater resources in the Planning Area have an economic value that is part of the overall economy of the area and that alterations to these resources, would have economic impacts to water users or to the regional economy. Affected users would include those who depend on surface water or groundwater for irrigation, ranching, municipal water needs, home water needs, landscape needs and any other business and household need of water from a surface water body or well.

Given the relatively limited scale of CBNG development proposed for Alternative A, effects on water resources and water resources economics would be relatively limited (see the analysis in the *Hydrological Resources* section). For Alternative A, untreated water from exploration would be placed in holding facilities for beneficial re-use, which would provide an economic benefit to affected water users. No discharge to waters of the United States would be allowed for BLM-authorized exploration wells; the state has permitted discharge for the CX Ranch field of

3,300 to 4,200 gpm of untreated and treated production water. Because of the small scale, no economic impacts to downstream surface water users would be anticipated.

Localized groundwater depletion would result over time (more than 5 years) from the CBNG wells proposed for Alternative A. However, state law (MCA 82-11-175) requires CBNG operators to offer a reasonable mitigation agreement to each person who holds an appropriation right or a permit to appropriate groundwater and for which the point of diversion is within one mile of a CBNG well; or one-half mile of a well that is adversely affected by CBNG well. These mitigation agreements must address the reduction or loss of water resources and must provide for prompt supplementation or replacement of water from any natural spring or water well adversely affected by the coal bed natural gas well.

Crow Reservation

Impacts to social and economic values on the Crow Reservation would be small because it is assumed that no CBNG wells would be developed on the Reservation initially. Social impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects potential. Few, if any, tax revenues would accrue to tribal governments as a result of off-reservation CBNG development. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer impacts from CBNG development.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be small because it is assumed that no CBNG wells would be developed on the Reservation. Social impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects potential. Few, if any, tax revenues would accrue to tribal governments as a result of off-reservation CBNG development. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer impacts from CBNG development.

Conclusions

The Alternative A management scenario is a continuation of existing oil and gas industry practices in the Planning Area and would not result in social impacts. They would be only a small effect on economic conditions in the Planning Area, as well as environmental and social conditions. However, there could be short term localized impacts to housing and services in Big Horn County.

The new jobs and related social and economic impacts from Alternative A would be small, with the exception of the proposed production wells in Big Horn County, which would result in positive economic impacts in that county. Future development in the area, such as further expansion of existing surface coal mines, would likely have larger social and economic impacts (e.g., creation of more jobs and income) than those impacts from Alternative A.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

As explained under the *Assumptions* section, most jobs created for CBNG development in Montana would likely be filled by Wyoming CBNG workers. In general, the scenario below lists greater economic benefits and greater social impacts than would likely occur.

Employment and Unemployment

Estimated direct employment from CBNG under the development scenario for the 20-year project life is presented in Table 4-59. (Wage information is discussed under *Economics*.) The number and type of jobs involved would vary with the project phase. The types of jobs would be the same as those described for Alternative A.

As shown in Table 4-59, development (drilling of about 18,300 wells over 20 years) would result in an estimated average of 851 jobs per year, with a range from 334 (Year 1) to 943 (Year 18) for all project phases combined. The actual number of jobs in a given year would depend on the actual number of wells drilled, in production, or abandoned in that year. Abandonment of wells during years 21-40 would result in an estimated 1,054 additional jobs, for an average of about 53 jobs per year during that period.

TABLE 4-59

ALTERNATIVES B, C, D, and E: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION, AND ABANDONMENT
(WAGES REPORTED IN CONSTANT DOLLARS)[1, 2]

Year	Wells Drilled per Year	Initial Development Jobs	Initial Development Wages[3]	Wells Producing per Year	Production Jobs	Production Wages	Wells Abandoned per Year	Abandonment Jobs	Abandonment Wages	Estimated Total Jobs	Estimated Total Wages
1	900	276	$7,993,125	510	29	$1,099,688	390	29	$1,011,563	334	$10,104,375
2	1,100	337	$9,769,375	1,220	69	$2,630,625	390	29	$1,011,563	435	$13,411,563
3	2,000	613	$17,762,500	2,830	159	$6,102,188	390	29	$1,011,563	801	$24,876,250
4	2,200	674	$19,538,750	4,640	261	$10,005,000	390	29	$1,011,563	964	$30,555,313
5	2,000	613	$17,762,500	6,250	352	$13,476,563	390	29	$1,011,563	993	$32,250,625
6	1,500	459	$13,321,875	7,750	436	$16,710,938	0	0	$0	895	$30,032,813
7	1,300	398	$11,545,625	9,050	509	$19,514,063	0	0	$0	907	$31,059,688
8	900	276	$7,993,125	9,950	560	$21,454,688	0	0	$0	835	$29,447,813
9	900	276	$7,993,125	10,850	610	$23,395,313	0	0	$0	886	$31,388,438
10	700	214	$6,216,875	11,550	650	$24,904,688	0	0	$0	864	$31,121,563
11	550	168	$4,884,688	11,900	669	$25,659,375	200	15	$518,750	853	$31,062,813
12	550	168	$4,884,688	12,250	689	$26,414,063	200	15	$518,750	873	$31,817,500
13	550	168	$4,884,688	12,600	709	$27,168,750	200	15	$518,750	892	$32,572,188
14	550	168	$4,884,688	12,950	728	$27,923,438	200	15	$518,750	912	$33,326,875
15	550	168	$4,884,688	13,300	748	$28,678,125	200	15	$518,750	932	$34,081,563
16	450	138	$3,996,563	13,550	762	$29,217,188	200	15	$518,750	915	$33,732,500
17	450	138	$3,996,563	13,800	776	$29,756,250	200	15	$518,750	929	$34,271,563
18	450	138	$3,996,563	14,050	790	$30,295,313	200	15	$518,750	943	$34,810,625
19	400	123	$3,552,500	14,100	793	$30,403,125	350	26	$907,813	942	$34,863,438
20	300	92	$2,664,375	14,050	790	$30,295,313	350	26	$907,813	908	$33,867,500
20-Year Total	18,300	5,604	$162,526,875		11,090	$425,104,688		319	$11,023,438	17,013	$598,655,000
Annual Average	915	280	$8,126,343.75		554	$21,255,234.38		16	$551,171.88	851	$29,932,750

NOTES:

[1]Data for jobs per well and wages (ZurMuehlen 2001).

[2]The water management conditions included in Alternative B would require injection wells, the installation and operation of which would be associated with additional jobs. Water injection wells would be required at a rate of about 1 per 10 CBM wells. This would result in an increase in jobs and wages of about 10% over those reported in this table.

[3]Wages paid for initial development phase for well drillers and pipeline installers was estimated at $6,600 per well (Langhus 2001).

The additional jobs created would be small compared to the total employment in the Planning Area (122,000 in 1998). However, given that most of the CBNG wells would be located in three counties (Big Horn, Powder River and Rosebud), a large number of the jobs would be concentrated in those counties. Because some of these jobs would go to non-local residents, the actual number of new jobs in the study area would be less.

The water management conditions included in Alternative B would require injection wells, the installation and operation of which would be associated with additional jobs. Water injection wells would be required at a rate of about 1 per 10 CBNG wells. This would result in an increase in jobs and wages of about 10 percent over those reported in Table 4-59 for all phases of the project combined.

In addition to the direct jobs created by the project, some additional jobs would be created indirectly through additional work for persons in related support industries such as truckers, material suppliers, inspectors and various other specialists. One estimate is that one indirect job would be created for every four direct jobs created (ZurMuehlen 2001).

The effect of the new jobs on current unemployment rates in the area would be moderate. Although the new direct jobs would help boost total employment in the Planning Area, the increases would be limited to those sectors and individuals with the appropriate skills for the jobs and to those geographic locations where the jobs are located. For example, the relatively high unemployment rates (about 9 percent) in the mining sector in Big Horn and Rosebud counties would be decreased if unemployed persons gain employment from the new CBNG development.

Any new jobs filled by new residents (see the *Demographics* section) would increase the number of employed persons in a given county but would not decrease the number of unemployed persons. To the extent that indirect jobs are created by the project, some increased employment in other service industries also would occur.

Demographics

As with Alternative A, employees who would fill the CBNG jobs would likely be a mixture of current residents from the surrounding areas and those who would be drawn to the project and its employment opportunities from around the region. It is assumed that local labor would be used to the extent it is available; however, for Alternative B it is likely that many additional workers (e.g., drill rig crews) from outside the area would be needed, especially during the peak employment years of the project. It is assumed that drill rigs from a variety of locations-both Montana and Wyoming-would be used, depending on supply and demand at any given time. The potential for new population is greatest in the counties where the number of CBNG wells to be drilled is greatest: Big Horn, Powder River and Rosebud counties (about 90 percent of proposed CBNG wells would be drilled in these three counties; see Table 4-60). As with Alternative A, it is estimated that, on average, each new employee would bring one additional person to the region. Assuming, for example, that all of the jobs were filled by new migrants to the area, as many as 1,986 people (993 x 2) might be added to the region during the peak employment year (Year 5). An increase of this magnitude would be small compared to the total regional population (196,000 in 2000). However, the new population could be concentrated in the three counties with the most CBNG wells (see Table 4-60).

Because these three counties have a relatively small combined population (about 24,000), population change within these counties could be substantial. Of the approximately 24,000 persons in the three counties, about 10,400 or 44 percent are Native American (see Chapter 3).

Social Organization

Housing Units and Vacancy

Depending on the type and duration of the jobs (e.g., long-term production supervisor versus drill rig crew member), new employees in the area would seek either temporary housing (hotels, apartments, trailer parking) or permanent housing (homes to purchase or to rent long-term). Individual choices about where to live are hard to predict and vary with personal preference, in addition to the supply of housing and availability of services in a given location and the mobility demands of a given job. The relatively limited supply of temporary and permanent housing in the smaller communities in the Planning Area would limit the number of new employees (and families, if applicable) who would be able to live there without additional housing and related services. The larger communities, such as Billings or Gillette and Sheridan, Wyoming, have a greater supply of temporary and permanent housing and would be likely settlement locations for people employed by the CBNG industry. In part because of the general trend of migration within Montana from the east to the west during recent years, vacant housing is available in a number of communities. As discussed in Chapter 3, vacancy rates for both temporary and permanent housing are adequate to high in the Planning Area. This information, combined with the large size of the geographic area and the dispersed nature of the new

TABLE 4-60

TOTAL PROJECTED WELLS AND PERCENT BY COUNTY

County	Alternatives B, C, D and E		Alternatives F and G	
	Wells to be Drilled	Percent of Total	Wells to be Drilled[1]	Percent of Total
Big Horn	7,000	38.3%	7,000	38.4%
Blaine	10	0.1%	0	0.0%
Carbon	400	2.2%	400	2.2%
Carter	0	0.0%	0	0.0%
Custer	300	1.6%	300	1.6%
Gallatin	15	0.1%	0	0.0%
Golden Valley	0	0.0%	0	0.0%
Musselshell	150	0.8%	150	0.8%
Park	25	0.1%	0	0.0%
Powder River	6,700	36.6%	6,700	36.7%
Rosebud	2,800	15.3%	2,800	15.3%
Stillwater	700	3.8%	700	3.8%
Sweetgrass	25	0.1%	0	0.0%
Treasure	25	0.1%	25	0.1%
Wheatland	0	0.0%	0	0.0%
Yellowstone	150	0.8%	150	0.8%
Subtotal	18,300	100.0%	18,225	100.0%
Combined Total:	16,500	90.2%	16,500	90.4%

Big Horn, Powder River, and Rosebud counties

[1]The number of wells to be drilled under Alternative G is approximately 65 percent less than Alternative F. However, the percent of total is the same for both alternatives.

job opportunities and associated new population, suggest that adequate housing opportunities would be available in the larger communities but might not be available in some of the smaller communities.

Public Services and Utilities

Impacts on the ability of local governments to provide public services and utilities would be related to the ability of the service providers to adapt to relevant fiscal or physical changes from CBNG development. Affected services typically include police and fire protection, emergency medical services, schools, public housing, park and recreation facilities, water supply, sewage and solid waste disposal, libraries, roads and other transportation infrastructure. Given the large geographic scale of the CBNG development scenario, it is infeasible to quantitatively assess the relationship of the project to these individual services. Effects would be greatest in the three counties (Big Horn, Powder River and Rosebud) where most of the CBNG wells are proposed to be drilled; however, these counties would also receive the greatest amounts of property tax and other government revenues (see the *Economics* section) that would fund improvements or other changes to services.

The alternatives being considered include varying management objectives with respect to the construction of roads and utilities. The construction and maintenance of utilities would be funded by the users. The decision as to whether to maintain roads

upon abandonment of CBNG facilities would be up to the land owner, which could be either a public or private entity. To the extent local governments opt to maintain these roads after this time, additional revenue would be required to balance the additional costs required to do so.

Attitudes, Beliefs, Lifestyles and Values

The large scale development of a large number of CBNG wells in the Planning Area would likely conflict with the attitudes, beliefs, lifestyles and values of many individuals and population subgroups in the area (e.g., farmers, ranchers, small town residents, Native Americans, retirees, etc.). Drilling, testing and operation of CBNG wells would result in increased traffic from trucks and other vehicles; noise from traffic and the operation of generators and drilling and other equipment; visual resource impacts from the construction of the wells themselves as well as power lines and related electrical infrastructure; and psychological stress associated with unwanted change, division in the community, or other impacts. The population subgroups would be affected to the degree to which their lifestyles and values are inconsistent with such impacts.

The majority of individuals in the Planning Area are understood to have traditional rural lifestyles in which the relatively quiet and pristine surroundings are an important value. They would likely find CBNG development inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. This would be particularly true for Big Horn, Powder River and Rosebud counties where the majority of the wells would be developed. Large-scale CBNG development could be viewed as part of a gradual transition away from traditional rural and agricultural lifestyles. A smaller group of people in the area who are more interested in the potential economic benefits of CBNG development would likely perceive or experience fewer impacts with respect to lifestyles and values.

Large-scale CBNG development is likely to conflict to some degree with traditional Native American values which emphasize preservation of cultural heritage and a reverence for the natural environment. Native American groups could be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular as they affect locations and resources used for spiritual or religious purposes. It is assumed that no CBNG wells would be developed on the Native American reservations initially and therefore impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects impact potential. It is likely that a smaller number of Native Americans who are interested in the development of energy resources for the long-term social and economic betterment of tribal members would perceive or experience fewer harmful impacts from CBNG development.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would need to be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

The subsurface discharge of produced water would likely be seen as consistent or somewhat inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. Impacts on groundwater would be the same for Alternatives B, C, D, E, F and H with the primary impact being the drawdown of groundwater.

Personal Income

Wages paid to CBNG workers would contribute to the total personal income in the county where the employees reside. As shown in Table 4-59, wages would be generated from all three project phases. Over the first 20 years of the project, total wages paid for all phases of the project would be an estimated $598 million. Estimated annual wages would range from $10 million in Year 1 to almost $35 million in Years 18 and 19. Although this much estimated personal income would be generated by the project, it would not all be experienced as "new" income within a given county or the state. New income would be the difference between the income of workers before CBNG development and the income after CBNG development.

A number of the producing wells in the development scenario would generate new personal income for those who own the land or the mineral rights, as stated under Alternative A. The circulation and re-circulation of direct income (including royalties to private owners) generated by the project would generate additional (indirect) personal income throughout the region.

Government Revenues

Oil and Gas Income

Assuming each of the approximately 16,500 production wells anticipated for Alternative B generate

about $182,500 in gross production income per year of operation, the total annual gross income would vary depending on the number of wells in production in a given year. As shown in Table 4-59, the estimated number of producing wells ranges from 510 in Year 1 to 14,100 in Year 19. It follows that the estimated annual gross income would range from $93 million (Year 1) to $2.5 billion (Year 19). Most of this revenue would go to methane companies and would accrue to the companies in the states where they are located. The 12.5 percent royalty collected on this annual income would range from about $12 million (Year 1) to $322 million per year. It is estimated that about one-half the well sites would be permitted on minerals administered by the federal government (BLM), about 5 to 10 percent on state (private) minerals and the remaining 40 to 50 percent on private minerals. As a result, about half of the royalty income would initially go to the federal government, with about half of the federal half being returned to the state. Thus, an estimated 30 to 35 percent of royalty income, between $4 million and $113 million in a given year, ultimately would accrue to the state. Given that total state revenues received from minerals management on state lands in FY 2000 was $11.6 million and total federal mineral revenues collected on Montana lands and disbursed to the state were $20.4 million in FY 2000 (see Chapter 3), new state revenues from CBNG would be substantial, especially during the peak years of the project.

Rents on state and federal lands leased for oil and gas development are bid competitively, with the lowest bid being $1.50 per acre. Resulting government income would depend on the specifics of the leases. It is assumed that additional income would accrue to the state and federal government from these rents.

Net government revenues would be reduced by costs incurred for monitoring and regulating CBNG activity. These costs would be relatively small compared to the revenues generated.

Water treatment costs for Alternative B would be greater than for Alternatives D, E and F and much greater than for Alternative C.

Taxes

Income Taxes

A portion of the taxable income (wages, rent or royalty income and land disturbance payments) generated by Alternative B would accrue to the state as income tax revenue. Income taxes would be paid on the annual wages paid for the average 851 jobs per year discussed above under *Employment*. Dividing the estimated total wages over 20 years by the estimated total jobs for the same period (Table 4-59), the average annual salary per job would be about $35,000 (does not account for inflation over time). Income in Montana is taxed according to a graduated rate structure with rates ranging from 2 percent to 11 percent of taxable income; the average rate in 2000 was about 3 percent (Montana Department of Revenue 2001). It is important to note that these sums are already included in the estimates of personal income (income taxes are a transfer of personal income to the state). Thus, estimated income tax revenues from an annual average of 851 jobs at $35,000 would range from $596,000 (2 percent tax rate) to $3.3 million (11 percent tax rate), with a likely amount closer to 894,000 (3 percent tax rate) based on recent history. As discussed above, the project would generate new income tax revenue for the state to the extent that revenue generated by new jobs, for example, exceeds existing tax revenues. The income tax sums are already included in the estimates of personal income.

Property Taxes

See general discussion of property taxes for Alternative A. Only at the time when a given property is improved (i.e., a CBNG well or other facilities are developed there) would estimated new property tax revenues be calculated. However, property taxes would accrue to counties roughly in proportion to the number of new wells. Big Horn, Powder River and Rosebud counties would have the vast majority of new wells; therefore, they would be anticipated to experience the greatest increases in assessed values and the greatest increase in new county property tax revenues. These new revenues could help improve schools, roads, community services and other county assets, after any new costs associated with CBNG are accounted for.

Natural Resources Taxes

Natural resources taxes would be greater than described under Alternative A because they would be based on 18,000 wells.

Other Taxes

Other taxes would be the same as described under Alternative A.

Water Resource Values

Surface discharge of produced water would be prohibited and therefore surface water impacts such as erosion and water quality would be avoided. In the absence of surface water impacts, no associated economic impacts to surface water users would occur.

The primary impact to groundwater resources is removal of groundwater in the Powder River Basin affecting wells and springs.

Crow Reservation

Social and economic impacts from off-Reservation development in Alternative B would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. It is anticipated the impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Some additional demands on public services also would result.

See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on effects to Native Americans.

As shown in the RFFA, 4,000 wells could be developed on the Crow Reservation. If this entire number of wells were developed, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, a drawdown in groundwater and additional personal income and revenues from CBNG development and production.

Indian allottees and the Crow Tribe would receive access, damage payments, royalties and possible tax revenues.

Northern Cheyenne Reservation

Social and economic impacts from off-Reservation development in Alternative B would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. It is anticipated the impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Some additional demands on public services also would result.

See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on effects to Native Americans.

As shown in the RFFA, 4,000 wells could be developed on the Northern Cheyenne Reservation. If this entire number of wells were developed, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, a drawdown in groundwater and additional personal income and revenues from CBNG development and production.

Indian allottees and the Northern Cheyenne Tribe would receive access, damage payments, royalties and possible taxes revenues.

Conclusion

The primary social impacts identified from Alternative B would be the new jobs created in the Planning Area as a result of development and change from a predominantly rural and agricultural based lifestyle. These new jobs would result in some demographic shifts as a result of people moving to the area. It is anticipated the impact of added employment and population on social conditions would be small overall but that impacts in the three counties with the most CBNG activity could be greater. Alternative B would result in the generation of new personal and government income. New personal income would include the wages from both direct and indirect jobs created by the project, as well as income from land disturbance payments and mineral leases. Similarly, new local, state and federal government income would be generated through the variety of means discussed. Over the long term, there is the possibility of a "boom and bust" cycle as CBNG activity rises and falls.

As shown in the RFD scenario presented in the Minerals Appendix, in addition to the 18,300 CBNG wells considered for Alternative B, an additional 8,200 CBNG wells would be developed in this area in the future: 4,000 on the Northern Cheyenne Reservation, 4,000 on the Crow Reservation and about 200 wells on USFS land. This number is about 44 percent of those proposed for Alternative B. If this entire number of wells was developed over the same 20-year period as the other 18,300 wells, additional economic impacts would occur. Such impacts would generally be in the form of new jobs and employment opportunities, additional population, additional demands on public services, a drawdown in groundwater and additional personal income and government revenues from CBNG development and production. Potentially large social and economic impacts also would result from other developments proposed for the area, including expansion of existing surface coal mines. The impacts from these other developments would be additive to those identified above for Alternative B.

Alternative C—Emphasize CBNG Development

Employment And Unemployment

Employment and unemployment would be the same as described under Alternative B, except that there would be no additional jobs created from installation of injection wells, which would not be required for this alternative.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would be the same as described under Alternative B.

Attitudes, Beliefs, Lifestyles and Values

General impacts on population subgroups are the same as for Alternative B.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

Alternative C would allow discharge of untreated water to the land surface. As indicated in the *Hydrological Resources* section, this discharge would result in erosion and water quality impacts. Such impacts would be inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. The primary reasons for this conclusion include the potentially large scale of this discharge, the potential for degraded water to negatively affect farming and ranching operations (e.g., reduce economic viability), increased noise, loss of natural scenery and the inconsistency of this approach with the rural lifestyles and values discussed in Chapter 3.

Personal Income

Personal income would be the same as described under Alternative B, with the possible exception of decreases in farming or ranching income as a result of water quality and erosion impacts. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to lifestyles and Values.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be about the same as described under Alternative B. Water treatment costs would be less than for Alternative B due to the allowance of discharge to the land surface (see *Water Resource Values* below).

Taxes

Income Taxes

Income taxes would be the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resources Taxes

Natural resources taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

See the discussions for Alternative B. Alternative C would allow discharge of untreated water to the land surface. As indicated in the *Hydrological Resources* section elsewhere in this document, this discharge would result in erosion and water quality impacts. In turn, some downstream surface water users who depend on surface water resources for their livelihood would be affected (for example, if suitable irrigation water were no longer available or if ranch land were lost to erosion). See further discussion under *Attitudes, Beliefs, Lifestyles and Values*, above. Groundwater impacts would be similar to Alternative B. A

difference is that no groundwater would be reinjected as it would for Alternative B, possibly increasing the risk of groundwater drawdown in some locations.

Crow Reservation

Impacts from Alternative C would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Crow Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Somewhat greater impacts on water resource users and on lifestyles and values would occur compared to Alternative B. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Northern Cheyenne Reservation

Social and economic impacts from development in Alternative C would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Northern Cheyenne Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Somewhat greater impacts on water resource users and on lifestyles and values would occur compared to Alternative B. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Conclusions

Residual impacts would be similar to those for Alternative B, except for impacts to lifestyles and water resource values, which would be greater for Alternative C than for Alternative B.

Cumulative impacts would be greater than for Alternative B, given the water resource impacts.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Employment and Unemployment

Employment and unemployment would be the same as described for Alternative B.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would be the same as described under Alternative B.

Attitudes, Beliefs, Lifestyles and Values

General impacts on population subgroups are the same as for Alternative B.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would be mitigated to minimize impacts. Exploratory activities such as drilling and testing would temporarily displace game species locally.

Treatment of most produced water and discharge via pipeline or other constructed water courses would eliminate most of the erosion and water quality impacts.

Personal Income

Personal income would be the same as described under Alternative B, with the possible exception of decreases in farming area ranching income as a result of water quality and erosion impacts. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to lifestyles and Values.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be the same as described under Alternative B. Water treatment costs would be greater than for Alternative C and much less than for Alternative B.

Taxes

Income Taxes

Income taxes would be the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resources Taxes

Natural resources taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

See discussion for Alternatives B and C. Most discharge would be treated and carried over land in pipes. Surface water impacts and the potential for resulting economic impacts to surface water users would be less than for Alternative C and greater than for Alternative B. Groundwater impacts would be the same as Alternative C.

Crow Reservation

Impacts from Alternative D would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. It is anticipated the impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Crow Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Additional impacts on water resource users and on lifestyles and values would occur but they would be less than for Alternative C. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Northern Cheyenne Reservation

Social and economic impacts from Alternative D would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. It is anticipated the impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Additional demands on public services also would result. Additional impacts on water resource users and on lifestyles and values would occur but they would be less than for Alternative C. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Conclusions

Residual impacts would be similar to those for Alternative B, except with respect to impacts on water resource economics and related lifestyle impacts, which would be less than Alternative C but greater than Alternative B.

Cumulative impacts would be less than Alternative C and somewhat greater than Alternative B, given the differences in water resource impacts.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Employment and Unemployment

Employment and unemployment would be the same as described under Alternative B. It is assumed that the approximate number of additional jobs created from installation of injection wells required for Alternative B would also occur for Alternative E, except that some of the jobs would be associated with the variety of site-specific produced water management options.

Demographics

Demographics would be the same as described under Alternative B.

Social Organization

Housing Units and Vacancy

Housing units and vacancy would be the same as described under Alternative B.

Public Services and Utilities

Public services and utilities would be the same as described under Alternative B, except that the oil and gas roads would remain open or be closed at the surface owner's discretion, potentially increasing or decreasing the burden on public jurisdictions to maintain these roads.

Attitudes, Beliefs, Lifestyles and Values

General impacts on population subgroups would be the same as for Alternative B.

Alternative E would have impacts on water resources and water resource values that are similar to the impacts of Alternative B and Alternative D (see *Hydrological Resources* section).

Personal Income

Personal income would be the same as described under Alternative B.

Government Revenues

Government revenues would be the same as described under Alternative B.

Oil and Gas Income

Oil and gas income would be about the same as described for Alternative B, although water treatment costs could be greater, thus potentially decreasing the net income to producers.

Taxes

Income Taxes

Income taxes would the same as described under Alternative B.

Property Taxes

Property taxes would be the same as described under Alternative B.

Natural Resource Taxes

Natural resource taxes would be the same as described under Alternative B.

Other Taxes

Other taxes would be the same as described under Alternative B.

Water Resource Values

Alternative E would have impacts on water resources and water resource values that are similar to the impacts of Alternative B and Alternative D (see discussion in *Hydrological Resources* section). The activities proposed to prevent the degradation of surface and groundwater resources would substantially reduce erosion and surface water quality impacts.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described above for Alternative E. Social and economic impacts would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Crow Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Compared to other alternatives, oil and gas income could be less, depending on water treatment costs. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described above for Alternative E. Social and economic impacts would include creation of a limited number of new jobs in the Planning Area and related demographic shifts from people moving to the area. The impact of added employment and population on social conditions on the Northern Cheyenne Reservation would be small. Some new personal and government income would be generated as discussed above. The effect of this new income on the Reservation would depend on a number of factors, including the extent to which Reservation members participate in the off-Reservation jobs or mineral ownership. Compared to other alternatives, oil and gas income could be less, depending on water treatment costs. See the *Attitudes, Beliefs, Lifestyles and Values* section under this alternative for additional information on social effects to Native Americans.

Social and economic impacts from CBNG development on federal lands would be mitigated as described in the Northern Cheyenne Mitigation Appendix. However, most measures focus on preventing the loss of tribal resources such as CBNG water. The BLM would consult with the tribe where site-specific analysis identifies social or economic impacts on the Reservation.

The Northern Cheyenne Tribe can require their special socioeconomic mitigation measures in tribal leases on the reservation.

Conclusions

Residual impacts would be similar to those for Alternative B, with the exception of the reduced impacts on lifestyles and values and water resource values that would result from the proposed measures to prevent the degradation of water resources.

Cumulative impacts would be somewhat less than for Alternative B, given the greater variety of control measures that would be used to prevent water resource impacts.

Alternative F—Phased Development Multiple Screens (High Range)

Because Alternative F would create fewer jobs annually and through completion of development than Alternatives B through E although wells would be drilled over a longer period of time, it is even more likely that jobs created under Alternative F would be filled by CBNG workers from Wyoming, as described in the *Assumptions* section.

The following discussion quantifies impacts associated with full development within the crucial sage-grouse habitat areas. If no development occurs in these areas, the socioeconomic impacts such as jobs and revenues would be approximately 12.8 percent lower. While this scenario would reduce revenues and jobs to some degree, there would be less demand placed on infrastructure, schools and other public services. The overall effect of reducing development impacts in the crucial sage-grouse habitat are expected to be less than the 12.8 percent reduction.

Employment and Unemployment

Employment changes resulting from Alternative F are shown in Table 4-61 and are expected to be lower than Alternatives B through E. Employment for Alternative F may be slightly higher than shown, since a small number of additional jobs would be created to manage produced water from the federal CBNG wells. While the types of jobs generated under this alternative would be similar to those generated under Alternatives B-E, the number of jobs and rate of jobs created per year are predicted to vary from the other alternatives. The number of wells drilled per year under Alternative F would be more constant than for the Alternatives B-E and H and would extend for an additional three years. This would result in fewer new jobs created annually, but new jobs created annually over a longer period of time compared to Alternatives B-E and H.

The numbers of jobs presented in Table 4-61 have been calculated on an annual basis. In year 1 of the development period, 217 new jobs are expected to be created to implement approved APDs. In year 2, 354 jobs would be required; however, 217 of these jobs would likely be filled by the workers employed in year 1. Consequently, the maximum number of workers needed in any one year would gradually increase over the development period from 217 to a peak of 1,039 in year 20, then gradually decrease as wells are abandoned.

Over the 23-year phased development period, an annual average of 774 jobs would be created by this alternative. This breaks out to an annual average of 243 initial development jobs, 523 production jobs and 8 well abandonment jobs created. There would be additional abandonment jobs after the development period (years 24 through 46). The total number of jobs created during the 23-year phased development period under Alternative F would be 14,707, as compared to 17,013 jobs during the 20-year development period for Alternatives B through E. The difference is mainly in the number of production jobs, which would be lower due to fewer producing wells per year as compared to other alternatives.

The effect of Alternative F on current unemployment rates in the area would be less than for Alternatives B through E. There would be a potential for some residents in the Planning Area to obtain these new jobs if they have the appropriate skills, which would directly reduce unemployment. However, most of the jobs created would likely go to Wyoming CBNG workers. Consequently, most of the indirect effects of this new employment (wages spent on support services) are expected to occur in Wyoming.

Demographics

Employees working in the CBNG industry in the Montana portion of the Powder River Basin would likely be commuting from Wyoming. Most of the existing CBNG operations in Montana are located near Decker, Montana, with Sheridan, Wyoming (located approximately 20 miles away), the closest community with a population large enough to support CBNG operations. In addition, much of the proposed drilling

TABLE 4-61

ALTERNATIVES F AND H: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION and ABANDONMENT (WAGES REPORTED IN CONSTANT DOLLARS)[1]

Year	Wells Drilled per Year	Initial Develop-ment Jobs[1]	Initial Development Wages[1]	Wells Producing Per Year[2]	Production Jobs[1]	Production Wages[1]	Wells Abandoned per Year[2]	Abandon-ment Jobs[1]	Abandon-ment Wages[1]	Estimated Total Jobs	Estimated New Jobs per Year	Estimated Total Wages
1	607	186	$5,390,919	546	31	$1,177,313	0	0	$0	217	217	$6,568,231
2	910	279	$8,081,938	1,336	75	$2,880,750	0	0	$0	354	137	$10,962,688
3	1074	329	$9,538,463	2,333	131	$5,030,531	0	0	$0	460	106	$14,568,994
4	1170	358	$10,391,063	3,386	190	$7,301,063	0	0	$0	549	89	$17,692,125
5	1074	329	$9,538,463	4,352	245	$9,384,000	0	0	$0	574	25	$18,922,463
6	910	279	$8,081,938	5,171	291	$11,149,969	0	0	$0	570	-4	$19,231,906
7	910	279	$8,081,938	5,991	337	$12,918,094	0	0	$0	616	46	$21,000,031
8	910	279	$8,081,938	6,810	383	$14,684,063	0	0	$0	662	46	$22,766,000
9	910	279	$8,081,938	7,628	429	$16,447,875	0	0	$0	708	46	$24,529,813
10	910	279	$8,081,938	8,447	475	$18,213,844	0	0	$0	754	46	$26,295,781
11	910	279	$8,081,938	9,266	521	$19,979,813	0	0	$0	800	46	$28,061,750
12	906	277	$8,046,413	10,081	567	$21,737,156	0	0	$0	845	45	$29,783,569
13	824	252	$7,318,150	10,823	609	$23,337,094	0	0	$0	861	17	$30,655,244
14	824	252	$7,318,150	11,565	651	$24,937,031	0	0	$0	903	42	$32,255,181
15	824	252	$7,318,150	12,307	692	$26,536,969	0	0	$0	945	42	$33,855,119
16	704	216	$6,252,400	12,941	728	$27,904,031	0	0	$0	944	-1	$34,156,431
17	703	215	$6,243,519	13,574	764	$29,268,938	0	0	$0	979	35	$35,512,456
18	654	200	$5,808,338	14,163	797	$30,538,969	0	0	$0	997	18	$36,347,306
19	543	166	$4,822,519	14,652	824	$31,593,375	0	0	$0	990	-6	$36,415,894
20	444	136	$3,943,275	15,052	847	$32,455,875	0	0	$0	983	-8	$36,399,150
21	509	156	$4,520,556	14,964	842	$32,266,125	546	41	$1,416,966	1,039	56	$38,203,647
22	496	152	$4,405,100	14,590	821	$31,459,688	819	61	$2,124,281	1,034	-5	$37,989,069
23	499	153	$4,431,744	14,072	792	$30,342,750	967	72	$2,507,119	1,017	-17	$37,281,613
23-Year Total	18,225	5,121	$161,860,781		9,586	$461,545,313	2,332	175	$6,048,366	14,707		$629,454,459
Annual Average	792	243	$7,037,425		523	$20,067,188	101	8	$262,972	774		$27,367,585

NOTES:

[1]Numbers of jobs and wages were calculated using the same method as Table 4-58. The numbers of jobs have been calculated on an annual basis. The maximum number of workers needed in any one year would gradually increase over the development period from 217 to a peak of 1.039 in year 20, then gradually decrease as the wells are abandoned.

[2]Numbers of production and abandonment wells are based on the assumption that 10% of all wells drilled would be dry holes.

in Montana would occur in four watersheds: Middle Powder River, Lower Powder River, Upper Tongue River and Lower Tongue River. These areas are located in the general vicinity of Sheridan, Buffalo and Gillette, Wyoming.

New temporary jobs related to CBNG could be created by drilling and construction activities, or the application of technology that requires additional employees, while new permanent jobs could be created to oversee additional production wells and facilities. The available jobs range from laborers and other field positions to technical/professional positions, such as geologists and engineers and other office staff positions. Additional support jobs could include surveyors and research scientists.

Most of the subcontracting companies used by CBNG companies operating in Montana are based in Wyoming. A small number of subcontracting companies and individual workers are from Montana. Job opportunities related to CBNG are advertised in both the Wyoming and Montana state job databases.

Social Organization

Housing Units and Vacancy

Most employees would commute from Wyoming, thus there would be little additional demand for housing in the Planning Area due to implementation of Alternative F.

Public Services and Utilities

Similarly, this alternative would have little effect on public services and utilities in the Planning Area, since most of the workers would be living in Wyoming rather than the Planning Area. The communities of Sheridan, Gillette and Buffalo, Wyoming, would most likely be affected by additional employees needed to support CBNG operations in the area of Montana with the greatest potential for CBNG development. Cumulative impacts to Wyoming communities are discussed in the *Impacts from Management Common to All Alternatives* section.

Attitudes, Beliefs, Lifestyles and Values

General impacts on population subgroups such as farmers, ranchers, small town residents, Native Americans and retirees, would be similar but are likely to have less effect than Alternatives B through E, particularly in the short-term (years 1-5 of the development period). Effects could include conflict with the attitudes, beliefs, lifestyles and values of many individuals. Drilling, testing and operation of CBNG wells would result in increased traffic from trucks and other vehicles; noise from traffic and the operation of generators and drilling and other equipment; visual resource impacts from the construction of the wells themselves, as well as power lines and related electrical infrastructure; and psychological stress associated with unwanted change, division in the community, or other impacts. The population subgroups would be affected to the degree to which their lifestyles and values are inconsistent with such impacts.

The majority of individuals in the Planning Area are understood to have traditional rural lifestyles in which the relatively quiet and pristine surroundings are an important value. They could find CBNG development inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. This would be particularly true for Big Horn, Powder River and Rosebud counties where the majority of the wells would be developed. Large-scale CBNG development could be viewed as part of a gradual transition away from traditional rural and agricultural lifestyles. Some people in the area who are more interested in the potential economic benefits of CBNG development would likely perceive or experience fewer impacts with respect to lifestyles and values.

Large-scale CBNG development is likely to conflict to some degree with traditional Native American values which emphasize preservation of cultural heritage and a reverence for the natural environment. Native American groups could be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular as these affect locations and resources used for spiritual or religious purposes. It is assumed that no CBNG wells would be developed on the Native American reservations initially and therefore impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects impact potential. It is likely that a smaller number of Native Americans who are interested in the development of energy resources would perceive or experience fewer harmful impacts from CBNG development.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would require mitigation to minimize impacts. Exploratory activities, such as drilling and testing, would temporarily displace game species locally. Less recreation area would likely be disturbed under Alternative F because the maximum level of federal well development would be limited in

each watershed and habitat disturbance would be limited.

The use of watershed-level analysis, water management plans and water balance projections as part of PODs would reduce the amount of erosion and water quality impacts expected from surface discharge of produced water. By use of watershed-level management of surface discharged water (i.e., 10 percent of 7Q10), impacts to surface water would be less than Alternative C and likely less than Alternative E.

The main difference under Alternative F would be that by limiting the number of federal wells approved each year per watershed, the overall rate of well development would be slower than for Alternatives B through E, especially in those areas where the greatest level of drilling would occur (the Upper Tongue, Lower Tongue and Middle Powder watersheds). For example, in year 4 (the year with the highest number of predicted wells), 2,200 wells would be drilled under Alternatives B through E versus 1,170 wells under Alternative F. While initial development under Alternatives B through E would likely be concentrated near areas that have already been developed, watershed-based limits under Alternative F would require development to be more dispersed among watersheds. Based on this more even development over time and among watersheds, combined with the 20/20 crucial habitat screen, the amount of habitat disturbance and fragmentation from federal wells would also be limited within each watershed.

This more even pace of development and restricted place of development may help residents adjust to the influx of CBNG development, but the impacts could last longer than under Alternatives B through E. Early in the phased development period, specific sources of noise, visual intrusion and surface disturbance would be less each year per watershed under this alternative than under Alternatives B through E because of the limits placed on approval of federal wells. In the later years of the development period, the sources of disturbance would be greater for this alternative as more federal wells would be developed than under Alternatives B through E. However, residents in the areas of CBNG development would still be impacted by any activities approved by the state.

Personal Income

Estimated CBNG wages for Alternative F are shown in Table 4-61. These wages would add to the total personal income mainly in the localities where employees reside (Wyoming). Wages would be produced from the development, production and abandonment phases. The estimated total wages over the phased development period would be $629,454,459. Annual wages are estimated to be $27,367,585, but would range from $6.6 million in year 1 to $38.2 million in year 21.

Income would also be generated by those who own the land or the mineral rights as described for Alternative A. Purchases made with CBNG income would produce some additional indirect income in the region as wages circulate through the economy. Most income from wages would likely be spent in Wyoming, where most CBNG workers live and income from land and mineral rights would likely be spent in Montana, where landowners live.

Government Revenues

Oil and Gas Income

Assuming that of the 18,225 wells drilled, approximately 10 percent would be dry holes leaving approximately 16,403 wells to generate production income. Production income under Alternative F would be expected to be lower than Alternatives B through E for years 3 through 17 and higher in the other years due to the limited number of APDs allocated per year.

Using the same production income as Alternative B, gross production income per year of operation would be approximately $182,500 per well. The number of producing wells would range from 546 in year 1 to 15,052 in year 20 (see Table 4-61). It follows that estimated annual gross income would range from $100 million (year 1) to $2.7 billion (year 20). Royalty income of 12.5 percent would range from $12 million (year 1) to $343 million (year 20), as compared to $12 to $322 million for Alternatives B through E. The maximum annual number of producing wells for this alternative would be higher than for Alternatives B through E (15,052 in year 20 versus 14,100 in year 18).

Distribution of production and royalty income to BLM, state (private) minerals and private minerals and income from rents and leases for oil and gas development would be similar to Alternative B. Generally, new state revenues from CBNG would be substantial. This source of state revenue would be more evenly spread over the phased development period under Alternative F as compared to Alternatives B through E. This would be a more constant source of income for the state, rather than a large infusion of revenue early in the program (years 1-5) that would dwindle over time.

Similar to Alternative B, government revenue from oil and gas would be reduced by costs for monitoring and regulating CBNG activity and water treatment. However, these costs are relatively small as compared to the gencrated revenue.

Under Alternative F, the Crow and Northern Cheyenne reservations would be protected from drawdown of eoal seam aquifers and drainage of tribal CBNG and groundwater resources by the establishment of a 5-mile buffer zone around the borders of the reservations. If the development of federal minerals within the 5-mile buffer zone is delayed or restricted while development on state and private leases continue, then the situation develops where there would be the increased potential for drainage of federal minerals. Within the 5-mile buffer zone of reservation boundaries, BLM managed minerals represent 24 percent (127,165 acres) of total mineral ownership (463,118 aeres) within the Billings RMP Area and 64 percent (250,565 acres) of total mineral ownership (355,307 acres) within the Powder River RMP Area. These federal minerals could contain as much as 1.4 to 1.6 TCF of gas that may be lost to the federal, state and county governments [(127,165 ae + 250,565 ac)/1 well site per 80 aeres * 0.3 to 0.34 BCF per well site]. The loss of royalties to the Federa! government would be approximately $1.2 billion at eurrent gas prices.

Alternative F differs from other alternatives in that Federal revenues and the assoeiated state revenues, eould be redueed if operators and BLM eannot find economie means of developing within the erucial sage-grouse habitat areas. If this transpires, then overall Federal royalties would be reduced by approximately $299,000,000 over the life of the field development. Similarly, private and State mineral estates may lose approximately $100,000,000 in royalties, assuming a similar royalty rate is paid to these mineral estate owners.

Taxes

Income Taxes

Ineome taxes would be somewhat lower than Alternative B due to the lower average number of estimated jobs (851 versus 774 jobs per year). However, sinee most of the workers are expected to eome from Wyoming, it is likely that most of the income taxes generated by CBNG development would be paid in Wyoming.

Property Taxes

Like Alternatives B through E, property taxes would accrue to counties roughly in proportion to the number of new wells. Big Horn, Powder River and Rosebud counties would have the vast majority of new wells; therefore, they would be antieipated to experience the greatest increases in assessed values and the greatest inerease in new county property tax revenues. These new revenues eould help improve schools, roads, community serviees and other county assets, after accounting for any new eosts assoeiated with CBNG. There eould be some slight difference between these alternatives related to whieh counties would accrue these taxes. This may be caused by focusing CBNG development by watersheds instead of other jurisdictional boundaries.

Natural Resources Taxes

Like the other alternatives, the products of natural resouree extraction in Montana, including natural gas, are subjeet to state natural resouree taxes, ineluding local government severanee taxes. Any new produetion of natural gas would be subjeet to such taxes. Severanee taxes are distributed to a variety of state and local funds and would contribute positively to the state and local economies.

Other Taxes

The local and state eeonomies would benefit from sales of goods and serviees by loeal businesses to oil and gas operators assoeiated with the projeet. However, local sales of goods and serviees assoeiated with CBNG development would not generate increases in tax revenues beeause there is no sales tax in Montana. In addition, most of the purchases associated with CBNG would likely be made in Wyoming.

Water Resource Values

Alternative F would have impacts on water resourees and water resouree values similar to Alternative E. However, disposal under this alternative would be managed on a watershed basis to reduee water quality impacts that may adversely affect downstream water users. Alternative H would allow limited discharge of untreated water under certain eonditions. The volume of diseharge from federal wells would be based on 10 percent of the 7Q10 flow ealculated from all CBNG wells at the downstream end of the watershed. If this 10 percent limit is being used by state or private wells, then no additional discharge of untreated water would be allowed from federal wells. Water produeed by federal wells may be treated, used for benefieial uses, or re-injeeted into the ground if the 10 pereent allowable discharge has already been exceeded.

Discharge of produced water into state waters would be allowed only under an approved State permit which would protect existing uses. Produced water put to benefieial use would provide an eeonomic benefit to affected water users.

As for Alternatives B though E, localized groundwater drawdown would oceur over time. The risk of such drawdown would likely be greater than Alternative B,

sinee reinjeetion of all produeed water is not required under this alternative. However, water well mitigation agreements would address the potential reduction or loss of water resourees and provide for prompt supplementation or replacement of water from any nearby natural spring or water well adversely affected by a CBNG well.

Crow Reservation

With lower numbers of jobs expeeted, Alternative F would result in somewhat lower social and economic impaets on the Crow Reservation as eompared to Alternatives B through E. Similar to other Montana residents, unless Crow tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill the jobs ereated by Alternative F.

Alternative F requires monitoring of federal CBNG development within 5 miles of the Crow Reservation. Site-speeifie groundwater and air quality analysis and mitigation measures would be required and implemented through the operator's Plan of Development. ITAs would be proteeted from federal CBNG wells loeated within 5 miles of the Crow Reservation and if analysis showed that ITAs would be adversely affeeted, then BLM would eonsult with the tribe and determine appropriate mitigation measures which may inelude not approving the APDs. BLM would require groundwater monitoring wells and air monitoring between the federal well field development area and the reservation. If this monitoring indieates ITAs are not being proteeted, then the wells would be shut in.

CBNG workers needing to travel from Sheridan or Gillette to the potential CBNG sites in the western part of the Planning Area would likely avoid traveling aeross the Crow Reservation by driving from Sheridan to Lovell, Wyoming or travel north from Powell, Wyoming or travel south from Billings, Montana. However, if CBNG development oeeurs on the Crow Reservation workers from Wyoming would enter the Crow Reservation.

Northern Cheyenne Reservation

Due to a lower number of new jobs expeeted and the faet that CBNG workers will not be erossing the Northern Cheyenne Reservation on their journey to work, exeept for the wells developed in the northern portion of the Planning Area, Alternative F would likely result in somewhat lower impaets on the Northern Cheyenne Reservation related to population, employment and soeial eonditions as Alternatives B through E. Like other Montana residents, unless Northern Cheyenne tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill the jobs ereated by Alternative F. Some off-site members may be eneouraged by perceived job opportunities to return to the Reservation, whieh eould inerease demand for public serviees. Some tribe members are eoneerned that inereased stress eaused by social ehanges due to CBNG development may also inerease the likelihood of aleoholism, drug abuse and family violence.

Alternative F would require monitoring of federal CBNG development within 5 miles of the Northern Cheyenne Reservation. These requirements would proteet ITAs and inelude site-speeifie groundwater and air quality analysis. This analysis would be ineluded in the operator's Plan of Development. ITAs would be protected from federal CBNG wells loeated within 5 miles of the Northern Cheyenne Reservation and if analysis showed that ITAs would be adversely affeeted, then BLM would eonsult with the tribe and determine appropriate mitigation measures whieh may include not approving the APDs. BLM would require groundwater and air monitoring between the federal well field development area and the Reservation. If this monitoring indieates ITAs are not being proteeted, then the wells would be shut in.

CBNG operators and subeontractors may need to drive across the Northern Cheyenne Reservation to reaeh some well sites in the northern part of the Planning Area (Rosebud County). Although the number of wells to be developed north of the Northern Cheyenne Reservation is relatively small, limited traffie, noise, safety and road maintenance impaets eould oeeur on the reservation. The Northern Cheyenne are eoneerned that this would inerease tribal member eontaet with outsiders, inereasing the negative effects of soeial ehange deseribed above. However, there is little reason for CBNG workers to stop on the reservation, as few serviees are offered on the reservation routes that would be used. Interaetion with eommuting workers would be of short duration and sporadie.

Conclusions

Soeial and economie impaets, sueh as employment, ineome, demographic migration, taxes, ehanges in lifestyle and soeial eonditions would likely be less than to those for Alternative B through E and there is less likely to be a "boom and bust" eyele assoeiated with Alternative F. Like the other alternatives, new jobs would likely be filled by CBNG workers from Wyoming. Under this alternative, CBNG development would be relatively steady over the phased development period, provided development continues and the demand for natural gas remains. Under the

other development alternatives, CBNG development would increase rapidly, peaking over a 5-year period and then decrease over the remainder of the development period. In addition, the social and economic impacts are likely to vary slightly from the other alternatives because development would occur based on watersheds, which may further spread CBNG development outside the three main counties most affected under Alternatives B through E (Big Horn, Powder River and Rosebud). This may reduce the overall impacts on social conditions and lifestyles.

The cumulative reduction in federal royalties due to the conditions placed on development within crucial sage-grouse habitat areas coupled with the 5-mile buffer development delay/restriction around reservations would result in a $1.5 billion loss to the federal government at current gas prices.

Cumulative water resource impacts from Alternative F would be less than Alternative C and E and more than Alternative B.

Alternative G—Phased Development Multiple Screens (Low Range)

Under Alternative G, fewer jobs would be created annually and through completion of development of all the Alternatives considered. Although wells would be drilled over a longer period of time, it is even more likely that jobs created under Alternative G would be filled by CBNG workers from Wyoming, as described in the *Assumptions* section.

Employment and Unemployment

CBNG employment under Alternative G is shown in Table 4-62 and would be similar (in the types of job opportunities) to Alternatives B through F. However, this alternative would result in a substantially lower number of new jobs, approximately 65 percent fewer jobs on average. The numbers of jobs presented in Table 4-62 have been calculated on an annual basis. In year 1 of the development period, 77 new jobs are expected to be created to implement approved APDs. In year 2, 126 jobs would be required; however, 77 of these jobs would likely be filled by the workers employed in year 1. Consequently, the maximum number of workers needed in any one year would gradually increase over the development period from 77 to a peak of 369 in year 21, then gradually decrease as wells are abandoned.

Under Alternative G, over the phased development period, an annual average of 275 jobs would be created. This breaks out to an annual average of 86 initial development jobs, 186 well production jobs and 3 well abandonment jobs. After the 23-year development period (years 24 through 46), there would be additional abandonment jobs. The total number of jobs created during the 23-year phased development period under Alternative G would be 6,323, as compared to 14,707 jobs during the 23-year phased development period under Alternative F and 17,013 jobs during the 20-year development period under Alternatives B through E.

Similar to other alternatives, limited phased CBNG development would create some new jobs for persons with the appropriate skills. However, the number of jobs created would be substantially less than the other development alternatives and it is not likely that this alternative would have a large effect on unemployment in the area as compared to other development alternatives.

Demographics

The type of effects from this alternative on demographics would be similar to Alternative F, while the amount of change would be less due to substantially fewer new jobs. As described under Alternative F, employees working in the CBNG industry in the Montana portion of the Powder River Basin would likely commute from Wyoming.

Most of the subcontracting companies used by CBNG companies operating in Montana are based in Wyoming. A small number of subcontracting companies and individual workers are from Montana. Job opportunities related to CBNG are advertised in both the Wyoming and Montana state job databases.

Social Organization

Housing Units and Vacancy

Like Alternative F, most employees under Alternative G would commute from Wyoming; thus, there would be little additional demand for housing in the Planning Area.

Public Services and Utilities

Similarly, this alternative would have little effect on public services and utilities within the Planning Area, since most of the workers would be living in Wyoming rather than the Planning Area. The highway connecting Sheridan to Decker would receive the most vehicle traffic related to CBNG operations in Montana.

The types of effects on public services and utilities would be similar to Alternative F, but less due to the lower number of expected new jobs. The communities of Sheridan, Gillette and Buffalo, Wyoming, would most likely be called upon to provide public services.

TABLE 4-62

ALTERNATIVE G: ESTIMATED WAGES AND JOBS FOR WELL DEVELOPMENT, PRODUCTION and ABANDONMENT (WAGES REPORTED IN CONSTANT DOLLARS)[1]

Year	Wells Drilled per Year	Initial Develop-ment Jobs[1]	Initial Development Wages[1]	Wells Producing Per Year[2]	Production Jobs[1]	Production Wages[1]	Wells Abandoned per Year[2]	Abandon-ment Jobs[1]	Abandon-ment Wages[1]	Estimated Total Jobs	Estimated New Jobs per Year	Estimated Total Wages
1	215	66	$1,909,469	194	11	$418,313	0	0	$0	77	77	$2,327,781
2	323	99	$2,868,644	486	27	$1,047,938	0	0	$0	126	50	$3,916,581
3	381	117	$3,383,756	829	47	$1,787,531	0	0	$0	163	37	$5,171,288
4	415	127	$3,685,719	1,204	68	$2,596,125	0	0	$0	195	32	$6,281,844
5	381	117	$3,383,756	1,547	87	$3,335,719	0	0	$0	204	9	$6,719,475
6	323	99	$2,868,644	1,838	103	$3,963,188	0	0	$0	202	-1	$6,831,831
7	323	99	$2,868,644	2,129	120	$4,590,656	0	0	$0	219	16	$7,459,300
8	323	99	$2,868,644	2,420	136	$5,218,125	0	0	$0	235	16	$8,086,769
9	323	99	$2,868,644	2,711	152	$5,845,594	0	0	$0	251	16	$8,714,238
10	323	99	$2,868,644	3,002	169	$6,473,063	0	0	$0	268	16	$9,341,706
11	323	99	$2,868,644	3,294	185	$7,102,688	0	0	$0	284	16	$9,971,331
12	322	99	$2,859,763	3,583	202	$7,725,844	0	0	$0	300	16	$10,585,606
13	293	90	$2,602,206	3,846	216	$8,292,938	0	0	$0	306	6	$10,895,144
14	293	90	$2,602,206	4,110	231	$8,862,188	0	0	$0	321	15	$11,464,394
15	293	90	$2,602,206	4,373	246	$9,429,281	0	0	$0	336	15	$12,031,488
16	250	77	$2,220,313	4,598	259	$9,914,438	0	0	$0	335	-1	$12,134,750
17	250	77	$2,220,313	4,823	271	$10,399,594	0	0	$0	348	13	$12,619,906
18	232	71	$2,060,450	5,033	283	$10,852,406	0	0	$0	354	6	$12,912,856
19	193	59	$1,714,081	5,206	293	$11,225,438	0	0	$0	352	-2	$12,939,519
20	158	48	$1,403,238	5,347	301	$11,529,469	0	0	$0	349	-3	$12,932,706
21	181	55	$1,607,506	5,316	299	$11,462,625	194	15	$501,891	369	20	$13,572,022
22	176	54	$1,563,100	5,182	291	$11,173,688	291	22	$754,003	367	-2	$13,490,791
23	177	54	$1,571,981	4,998	281	$10,776,938	343	26	$889,397	361	-6	$13,238,316
23-Year Total	6,470	1,982	$57,470,569		4,279	$164,023,781	827	62	$2,145,291	6,323		$223,639,641
Annual Average	281	86	$2,498,720		186	$7,131,469	36	3	$93,274	275		$9,723,463

NOTES:

[1]Numbers of jobs and wages were calculated using the same method as Table 4-58. The numbers of jobs have been calculated on an annual basis. The maximum number of workers needed in any one year would gradually increase over the development period from 77 to a peak of 369 in year 21, then gradually decrease as the wells are abandoned.

[2]Numbers of production and abandonment wells are based on the assumption that 10% of all wells drilled would be dry holes.

emergency services and support services for employees and their families.

Cumulative impacts to Wyoming communities are discussed in the *Impacts from Management Common to All Alternatives* section

Attitudes, Beliefs, Lifestyles and Values

The type of impacts on population subgroups such as farmers, ranchers, small town residents, Native Americans, retirees under Alternative G would be similar to Alternative F. However, this alternative is anticipated to have a greatly reduced effect on attitudes, values, beliefs and lifestyles as compared to other alternatives (see below for details). Not only is the location of development more restricted than Alternatives B through E (Alternative G is similar to Alternative F in that well location development is restricted by watershed), but the pace of development is greatly reduced even over Alternative F. Thus, under Alternative G, noise, visual impacts and surface disturbance would be minimized as compared to the other alternatives. In addition, less recreational or habitat areas would be disturbed.

Although Alternative G would have fewer effects on attitudes, values, beliefs and lifestyles, the development of CBNG wells would still result in increased traffic from trucks and other vehicles; noise from traffic and the operation of generators and drilling and other equipment; visual resource impacts from the construction of the wells themselves as well as power lines and related electrical infrastructure; and psychological stress associated with unwanted change, division in the community, or other impacts. The population subgroups would be affected to the degree to which their lifestyles and values are inconsistent with such impacts.

The majority of individuals in the Planning Area are understood to have traditional rural lifestyles in which the relatively quiet and pristine surroundings are an important value. They could find CBNG development inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports, although they may find Alternative G more acceptable. Some people in the area who are more interested in the potential economic benefits of CBNG development would likely perceive or experience fewer impacts with respect to lifestyles and values.

Alternative G may be more acceptable with Native Americans and may conflict less with traditional Native American values, which emphasize preservation of cultural heritage and a reverence for the natural environment. However, Native American groups could still be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular as these affect locations and resources used for spiritual or religious purposes. It is assumed that no CBNG wells would be developed on the Native American reservations initially and therefore impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects impact potential. It is likely that a smaller number of Native Americans who are interested in the development of energy resources would perceive or experience fewer harmful impacts from CBNG development.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would require mitigation to minimize impacts. Exploratory activities, such as drilling and testing, would temporarily displace game species locally. Less recreation area would likely be disturbed under Alternative G than the other Alternatives.

As for Alternative F, the use of watershed-level analysis, water management plans and water balance projections as part of PODs would reduce the amount of erosion and water quality impacts expected from surface discharge of produced water. By use of watershed-level management of surface discharged water (i.e., 10 percent of 7Q10), as well as a lower level of development, impacts to surface water would be less than Alternatives C, E and F.

More than any other alternative, Alternative G limits the number of federal wells approved each year per watershed, so the overall rate of well development would be slower than for Alternatives B through F, especially in those areas where the greatest level of drilling would occur, such as the Upper Tongue, Lower Tongue and Middle Powder watersheds. For example, in year 4 (the year with the highest number of predicted wells), 2,200 wells would be drilled under Alternatives B through E versus 416 wells under Alternative G. The number of federal wells and the amount of habitat disturbance and fragmentation from federal wells would also be limited in each watershed.

This lower level and more even pace of development and restricted place of development may help residents adjust to the influx of CBNG development, but the impacts could last longer than under Alternatives B through E. Throughout the phased development period, specific sources of noise, visual intrusion and surface disturbance would be less each year per watershed under this alternative than the other development

alternatives. However, residents in the areas of CBNG development would still be impacted by any activities approved by the State.

Personal Income

The estimated wages for Alternative G are shown in Table 4-62. Similar to other development alternatives, the wages earned from CBNG development would directly increase personal income for those working in the CBNG industry and indirectly increase personal income for persons working in other economic sectors where CBNG workers may spend income. Like the other alternatives, most of the direct and indirect income would go to workers in Wyoming. The predicted total wages over the phased development period for Alternative G would be $223,639,641. As compared to Alternative F, this alternative would produce approximately 35 percent as much personal income ($629,454,459 versus $223, 639,641). Income would also be generated by persons who own the land or mineral rights where drilling would occur similar to Alternative A.

Government Revenues

Oil and Gas Income

Assuming that 10 percent of the 6,470 wells drilled under this alternative would be dry holes, approximately 5,822 wells would remain to generate production income. Using the same production income ratio as Alternative B, gross production income per year of operation would be approximately $182,500 per well. The number of producing wells would range from 194 in year 1 to 5,341 in year 20 (see Table 4-62). It follows that estimated annual gross income would range from $35 million (year 1) to $976 million (year 20). Royalty income of 12.5 percent would range from $4.4 million (year 1) to $12 million (year 20). The oil and gas income generated under Alternative G would be significantly less than other development alternatives as income for other development alternatives is as high as $2.7 billion.

Taxes

Income Taxes

The estimated average yearly income tax revenue generated by Alternative G would be $289,000, assuming a three percent tax rate. Alternative G would generate $605,000 less tax revenue than Alternatives B through E and $524,000 less than Alternative F. However, since most of the jobs are expected to be filled by workers living in Wyoming, most of these taxes would likely be paid in Wyoming.

Property Taxes

Like Alternatives B through F, property taxes would accrue to counties roughly in proportion to the number of new wells. Big Horn, Powder River and Rosebud counties would have the majority of new wells; therefore, they would be anticipated to experience the greatest increases in assessed values and the greatest increase in new county property tax revenues. These new revenues could help improve schools, roads, community services and other county assets, after accounting for any new costs associated with CBNG. Property taxes would be lower for Alternative G than the other alternatives because fewer wells would be developed. Similar to Alternative F, which would focus CBNG development by watershed instead of other jurisdictional boundaries, there could be some differences related to which counties accrue the taxes.

Natural Resources Taxes

Like the other alternatives, the products of natural resource extraction in Montana, including natural gas, are subject to state natural resource taxes, including local government severance taxes. Any new production of natural gas would be subject to such taxes. Severance taxes are distributed to a variety of state and local funds and would contribute positively to the state and local economies. Natural Resources taxes would be lower for Alternative G than the other alternatives because fewer wells would be developed. There could be some slight difference between these alternatives related to which counties would accrue these taxes. This may be caused by limiting CBNG development by watershed instead of other jurisdictional boundaries.

Other Taxes

The local and state economies would benefit from sales of goods and services by local businesses to oil and gas operators associated with the project. However, local sales of goods and services associated with CBNG development would not generate increases in tax revenues because there is no sales tax in Montana. In addition, most of the purchases associated with CBNG would likely be made in Wyoming

Water Resource Values

Alternative G would produce less water, but due to discharge limitations, it would likely have impacts on water resources and water resource values similar to Alternatives C, D, E and F. Like Alternative F, this alternative would allow limited discharge of untreated water under certain conditions. The volume of discharge from federal wells would be based on 10 percent of the 7Q10 flow calculated from all CBNG

wells at the downstream end of the watershed. If this 10 percent limit is being used by state or private wells, then no additional discharge of untreated water would be allowed from federal wells. Water produced by federal wells may be treated, used for beneficial uses, or re-injected into the ground if the 10 percent allowable discharge has already been exceeded.

Discharge of produced water into State waters would be allowed only under an approved State permit which would protect existing uses. Produced water put to beneficial use would provide an economic benefit to affected water users.

As for Alternatives B though F, localized groundwater drawdown would occur over time. The risk of such drawdown would likely be greater than Alternative B, since reinjection of all produced water is not required under this alternative, but less than Alternatives C through F due to the reduced level of development. Water well mitigation agreements would address the potential reduction or loss of water resources and provide for prompt supplementation or replacement of water from any nearby natural spring or water well adversely affected by a CBNG well.

Crow Reservation

The types of social and economic impacts of Alternative G on the Crow Reservation would be similar to Alternative F. However, the magnitude of impacts would be lower with fewer expected new jobs. Similar to other Montana residents, unless Crow tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill jobs created by Alternative G.

Similar to Alternative F, Alternative G would require monitoring of federal CBNG development within 5 miles of the Crow Reservation. Site-specific groundwater and air quality analysis and mitigation measures would be required and implemented through the operator's Plan of Development. ITAs would be protected from federal CBNG wells located within 5 miles of the Crow Reservation and if analysis showed that ITAs would be adversely affected, then BLM would consult with the tribe and determine appropriate mitigation measures which may include not approving the APD. BLM may require groundwater monitoring wells and air monitoring between the federal well field development area and the reservation. If this monitoring indicates ITAs are not being protected, then the wells would be shut in.

CBNG workers needing to travel from Sheridan or Gillette to the potential CBNG sites in the western part of the Planning Area would likely avoid traveling across the Crow Reservation by driving from Sheridan to Lovell, Wyoming or travel north from Powell, Wyoming or travel south from Billings, Montana. However, if CBNG development occurs on the Crow Reservation, workers from Wyoming would enter the Crow Reservation.

Northern Cheyenne Reservation

The types of social and economic impacts of Alternative G on the Northern Cheyenne Reservation would be similar to Alternative F, although the amount of impacts would be lower due to fewer expected new jobs. Similar to other Montana residents, unless Northern Cheyenne tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill jobs created by Alternative F. Some off-site members may be encouraged by perceived job opportunities to return to the Reservation, which could increase demand for public services. Some tribe members are concerned that increased stress caused by social changes due to CBNG development may also increase the likelihood of alcoholism, drug abuse and family violence.

Similar to Alternative F, Alternative G would require monitoring of federal CBNG development within 5 miles of the Northern Cheyenne Reservation. Site-specific groundwater and air quality analysis and mitigation measures would be required and implemented through the operator's Plan of Development. ITAs would be protected from federal CBNG wells located within 5 miles of the Northern Cheyenne Reservation and if analysis showed that ITAs would be adversely affected, then BLM would consult with the tribe and determine appropriate mitigation measures which may include not approving the APD. BLM may require groundwater monitoring wells and air monitoring between the federal well field development area and the reservation. If this monitoring indicates ITAs are not being protected, then the wells would be shut in.

Like Alternative F, CBNG operators and subcontractors may need to drive across the Northern Cheyenne Reservation to reach some well sites in the northern part of the Planning Area (Rosebud County). Although the number of wells to be developed north of the Northern Cheyenne Reservation is relatively small, limited traffic, noise, safety and road maintenance impacts could occur on the reservation. The Northern Cheyenne are concerned that this would increase tribal member contact with outsiders, increasing the negative effects of social change described above. However, there is little reason for CBNG workers to stop on the reservation, as few services are offered on the reservation routes that would be used. Interaction with

commuting workers would be of short duration and sporadic.

Conclusions

Generally, the social and economic impacts resulting from Alternative G would be less than the other alternatives because of the greatly reduced number of federal wells that would be drilled. Also, a "boom and bust" cycle would be less likely as compared to the other alternatives, since CBNG development would be relatively steady over the phased development period, provided that development continues and the demand for natural gas remains.

Cumulative water resource impacts from Alternative G would be similar in nature to those expected from Alternative F. However, the magnitude of impacts would be less than Alternative F, as well as all the other development alternatives, due to the lower number of federal wells developed.

Alternative H—Preferred Alternative - Multiple Screens

Under this Alternative, impacts would be similar to Alternative F. Alternative H manages the pace (rate) and place (geography) of federal CBNG development through protection measures applied to crucial habitat areas and limits to the discharge of untreated produced water from federal CBNG wells and emissions from sources associated with federal CBNG wells. More federal APDs could be approved annually and geographically than under Alternatives F and G to the extent that full field development could eventually occur under Alternative H as long as other resources are protected. Monitoring data would be required to help BLM determine which (where and when) federal APDs could be approved. These limits and thresholds (see Wildlife Appendix and Hydrology section) would serve to level the cumulative impacts over time. The production of CBNG would continue for a longer overall period of time compared to Alternative E because fewer number of federal CBNG wells may be drilled each year.

With these screens, the overall rate of well development would likely be about the same as Alternative F and slower than for Alternatives B through E, especially in those areas where the greatest level of drilling would occur, such as the Upper Tongue, Lower Tongue and Middle Powder watersheds. If no development occurs in the screen areas as a result of monitoring data, socioeconomic impacts including jobs and revenues could be reduced by as much as 12.8 percent. However, if monitoring data allows for the full field development of the screen areas, jobs and revenues could reach the levels predicted under the full field development alternative.

Employment and Unemployment

The development of wells for Alternative H is expected to follow the same pattern as Alternative F; therefore, employment for this alternative would be similar to Alternative F. Employment for Alternative F is shown in Table 4-61. Like Alternative F, Alternative H employment is expected to be lower than Alternatives B through E, but higher than Alternatives A and G. As for Alternative F, employment for Alternative H may be slightly higher than shown in Table 4-61, since a small number of additional jobs would be created to manage produced water from the federal CBNG wells. While the types of jobs generated under this alternative would be similar to those generated under the other development alternatives, the number of jobs and rate of jobs created per year are predicted to vary from the other alternatives. The number of wells drilled per year under Alternative H would be limited by the application of the four resource screens and watershed-level analysis, rather than a specific annual numerical limit on number of approved APDs. Therefore the number of wells developed each year could vary somewhat from what is predicted under Alternative F.

The numbers of jobs presented in Table 4-61 have been calculated on an annual basis. In year one of the development period, 217 new jobs are expected to be created to implement approved APDs. In year two, 354 jobs would be required; however, 217 of these jobs would likely be filled by the workers employed in year one. Consequently, the maximum number of workers needed in any one year would gradually increase over the development period from 217 to a peak of 1,039 in year 20, then gradually decrease as wells are abandoned.

Over the 23-year development period, there would be an annual average of 774 jobs created. This breaks out to an annual average of 243 initial development jobs, 523 production jobs and 8 well abandonment jobs created. Additional abandonment jobs would be created after the development period. Like Alternative F, the total number of jobs created during the 23-year phased development period under Alternative H would be 14,707, as compared to 17,013 jobs during the 20-year development period for Alternatives B through E.

The effect of Alternative H on current unemployment rates in the area could be less than for Alternatives B through E. There is a potential for some residents in the Planning Area to obtain these new jobs if they have the appropriate skills, which would directly reduce unemployment, but most of the jobs created would

likely be filled by CBNG workers living in Wyoming. Since most jobs created would go to Wyoming residents, most of the indirect effects of this new employment (wages spent on support services) would also occur in Wyoming.

Demographics

Employees working in the CBNG industry in the Montana portion of the Powder River Basin would likely commute from Wyoming. Most of the existing CBNG operations in Montana are located near Decker, Montana, with Sheridan, Wyoming (located approximately 20 miles away), the closest community with a population large enough to support CBNG operations. In addition, much of the proposed drilling in Montana would occur in four watersheds: Middle Powder River, Lower Powder River, Upper Tongue River and Lower Tongue River. These areas are located in the general vicinity of the towns listed above.

New temporary jobs related to CBNG could be created by drilling and construction activities, or the application of technology that requires additional employees, while new permanent jobs could be created to oversee additional production wells and facilities. The available jobs range from laborers and other field positions to technical/professional positions such as geologists and engineers and other office staff positions. Additional support jobs include surveyors and research scientists.

Most of the subcontracting companies used by CBNG companies operating in Montana are based in Wyoming. A small number of subcontracting companies and individual workers are from Montana. Job opportunities related to CBNG are advertised in both the Wyoming and Montana state job databases.

Social Organization

Housing Units and Vacancy

Effects on housing would be similar to Alternative F. Most employees would commute from Wyoming, thus there would be little additional demand for housing in the Planning Area due to implementation of this alternative.

Public Services and Utilities

Similarly, this alternative would have little effect on public services and utilities since most of the workers would be living in Wyoming rather than the Planning Area. The highway connecting Sheridan to Decker would receive the most vehicle traffic related to CBNG operations in Montana. The communities of Sheridan, Gillette and Buffalo, Wyoming, would most likely be affected by additional employees needed to support CBNG operations in the area of Montana with the greatest potential for CBNG development. These communities, especially Sheridan, would continue to be called upon to provide public services, emergency services and support services for employees and their families.

Cumulative impacts to Wyoming communities are discussed in the *Impacts from Management Common to All Alternatives* section.

Attitudes, Beliefs, Lifestyles and Values

General impacts on population subgroups such as farmers, ranchers, small town residents, Native Americans and retirees, would be similar to Alternative F. Effects could include conflict with the attitudes, beliefs, lifestyles and values of many individuals. Drilling, testing and operation of CBNG wells would result in increased traffic from trucks and other vehicles; noise from traffic and the operation of generators and drilling and other equipment; visual resource impacts from the construction of the wells themselves, as well as power lines and related electrical infrastructure; and psychological stress associated with unwanted change, division in the community, or other impacts. The population subgroups would be affected to the degree to which their lifestyles and values are inconsistent with such impacts.

The majority of individuals in the Planning Area are understood to have traditional rural lifestyles in which the relatively quiet and pristine surroundings are an important value. They could find CBNG development inconsistent with the desired balance between environmental stewardship and economic development expressed in many of the scoping comments and newspaper reports. This would be particularly true for Big Horn, Powder River and Rosebud counties where the majority of the wells would be developed. Large-scale CBNG development could be viewed as part of a gradual transition away from traditional rural and agricultural lifestyles. Some people in the area who are more interested in the potential economic benefits of CBNG development would likely perceive or experience fewer impacts with respect to lifestyles and values.

CBNG development is likely to conflict to some degree with traditional Native American values which emphasize preservation of cultural heritage and a reverence for the natural environment. Native American groups could be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular as these affect locations

and resources used for spiritual or religious purposes. It is assumed that no CBNG wells would be developed on the Native American reservations initially and therefore impacts would be more likely to affect those individuals living off the reservations or whose activities are conducted off the reservations. Native American development is considered as part of the cumulative effects impact potential. It is likely that a smaller number of Native Americans who are interested in the development of energy resources would perceive or experience fewer harmful impacts from CBNG development.

Impacts on recreation areas would include the loss of land for recreation purposes and the disruption to recreation activities. Each well would present its own set of unique circumstances that would require mitigation to minimize impacts. Exploratory activities, such as drilling and testing, would temporarily displace game species locally. Less recreation area would likely be disturbed compared to Alternatives B through E because the level of federal well development would likely be lower in each watershed and habitat disturbance would be limited.

As for Alternative F, the use of watershed-level analysis, water management plans and water balance projections as part of PODs would reduce the water quality impacts expected from surface discharge of produced water. By use of watershed-level management of surface discharged water (i.e., 10 percent of 7Q10), impacts to surface water would be less than Alternative C and likely less than Alternative E.

The rate of development may not be as even as Alternative F if the screens allow more development. This may concentrate the effect of development in earlier years more than Alternative F, but likely still less than Alternatives B through E. Residents in the areas of CBNG development would still be impacted by any activities approved by the State.

Personal Income

Estimated CBNG wages for Alternative H would be about the same as shown in Table 4-61 for Alternative F. These wages would add to the total personal income mainly in the localities where employees reside (Wyoming). Wages would be produced from the development, production and abandonment phases. The estimated total wages over the phased development period would be $629,454,459. Annual wages are estimated to be $27,367,585, but would range from $6.6 million in year 1 to $38.2 million in year 21.

Income would also be generated by those who own the land or the mineral rights as described for Alternative A. Purchases made with CBNG income would produce some additional indirect income in the region as earnings circulate through the economy. Most of this would likely be spent in Wyoming, where workers are expected to reside.

Government Revenues

Oil and Gas Income

Assuming that of the 18,225 wells drilled, approximately 10 percent would be dry holes, then approximately 16,403 wells would be left to generate production income. Production income under Alternative H would be expected to be about the same as Alternative F and lower than Alternatives B through E.

Using the same production income as Alternative B, gross production income per year of operation would be approximately $182,500 per well. The number of producing wells would range from 546 in year 1 to 15,052 in year 20 (see Table 4-61). It follows that estimated annual gross income would range from $100 million (year 1) to $2.7 billion (year 20). Like Alternative F, royalty income of 12.5 percent would range from $12 million (year 1) to $343 million (year 20), as compared to $12 to $322 million for Alternatives B through E. There is no maximum annual number of producing wells for this alternative, although the screens would limit well development.

Distribution of production and royalty income to BLM, state (private) minerals and private minerals and income from rents and leases for oil and gas development would be similar to Alternatives B and F. Generally, new state revenues from CBNG would be substantial. This source of state revenue could be more evenly spread over the development period like Alternative F. If this occurs, this would be a more constant source of income for the state, rather than a large infusion of revenue early in the program (years 1-5) that would dwindle over time.

Similar to Alternative B and F, government revenue from oil and gas would be reduced by costs for monitoring and regulating CBNG activity and water treatment. However, these costs are relatively small as compared to the generated revenue.

Under Alternative H, the Crow and Northern Cheyenne reservations would be protected from drawdown of coal seam aquifers and drainage of tribal CBNG and groundwater resources by the establishment of a 5-mile buffer zone around the borders of the reservations. If the development of federal minerals within the 5-mile buffer zone is delayed or restricted while development on state and private leases continue, then the situation develops

where there would be the increased potential for drainage of federal minerals. Within the 5-mile buffer zone of reservation boundaries, BLM managed minerals represent 24 percent (127,165 acres) of total mineral ownership (463,118 acres) within the Billings RMP Area and 64 percent (250,565 acres) of total mineral ownership (355,307 acres) within the Powder River RMP Area. These federal minerals could contain as much as 1.4 to 1.6 TCF of gas that may be lost to the federal, state and county governments [(127,165 acres + 250,565 acres)/1 well site per 80 acres * 0.3 to 0.34 BCF per well site]. The loss of royalties to the Federal government would be approximately $1.2 billion at current gas prices.

These statistics do not take into account the federal minerals administered by the Custer National Forest, Ashland Ranger District.

Taxes

Income Taxes

Income taxes generated from CBNG development would be similar to Alternative F and they would likely be paid in Wyoming, since most workers are expected to come from that state.

Property Taxes

Like the other alternatives, property taxes would accrue to counties roughly in proportion to the number of new wells. Big Horn, Powder River and Rosebud counties would have the vast majority of new wells; therefore, they would likely experience the greatest increases in assessed values and the greatest increase in new county property tax revenues. These new revenues could help improve schools, roads, community services and other county assets, after accounting for any new costs associated with CBNG. There could be some slight difference between the alternatives related to which counties would accrue these taxes. This may be caused by limiting CBNG development by watersheds instead of other jurisdictional boundaries.

Natural Resources Taxes

Like the other alternatives, the products of natural resource extraction in Montana, including natural gas, are subject to state natural resource taxes, including local government severance taxes. Any new production of natural gas would be subject to such taxes. Severance taxes are distributed to a variety of state and local funds and would contribute positively to the state and local economies.

Other Taxes

The local and state economies would benefit from sales of goods and services by local businesses to oil and gas operators associated with the project. However, local sales of goods and services associated with CBNG development would not generate increases in tax revenues because there is no sales tax in Montana. In addition, most of the purchases associated with CBNG development would likely be made in Wyoming.

Water Resource Values

Due to the water screen, Alternative H would have impacts on water resources and water resource values similar to or less than Alternatives C through F. This alternative would allow limited discharge of untreated water under certain conditions. The volume of discharge from federal wells would be based on 10 percent of the 7Q10 flow calculated from all CBNG wells at the downstream end of the watershed. The 10 percent limit would not apply if surface water monitoring is being conducted above and below the proposed outfalls. If surface water monitoring indicates a water quality threshold would be exceeded, no further untreated discharge would be allowed from federal wells upstream from the station. Previously approved water management plans may be modified or rescinded if monitoring indicates unacceptable impacts are occurring. Water quality thresholds and the surface water monitoring requirements are detailed in the Hydrology Appendix. Water produced by federal wells may be treated, used for beneficial uses, or re-injected into the ground if the 10 percent allowable discharge has already been exceeded.

Discharge of produced water into State waters would be allowed only under an approved State permit which would protect existing uses. Produced water put to beneficial use would provide an economic benefit to affected water users.

As for Alternatives B though F, localized groundwater drawdown would occur over time. The risk of such drawdown would likely be greater than Alternative B, since reinjection of all produced water is not required under this alternative. However, water well mitigation agreements would address the potential reduction or loss of water resources and provide for prompt supplementation or replacement of water from any nearby natural spring or water well adversely affected by a CBNG well.

Crow Reservation

Alternative H would result in similar social and economic impacts on the Crow Reservation as

Alternative F. Similar to other Montana residents, unless Crow tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill the jobs created by Alternative H. Alternative H requires monitoring of federal CBNG development within 5 miles of the Crow Reservation. Site-specific groundwater and air quality analysis and mitigation measures would be required and implemented through the operator's Plan of Development. Indian Trust Assets (ITAs) would be protected from federal CBNG wells located within 5 miles of the Crow Reservation and if analysis showed that ITAs would be adversely affected, then BLM would consult with the tribe and determine appropriate mitigation measures which may include not approving the APD. BLM would require groundwater monitoring wells and air monitoring between the federal well field development area and the reservation. If this monitoring indicates ITAs are not being protected, then the wells would be shut in.

CBNG workers needing to travel from Sheridan or Gillette to the potential CBNG sites in the western part of the Planning Area would likely avoid traveling across the Crow Reservation by driving from Sheridan to Lovell, Wyoming or travel north from Powell, Wyoming or travel south from Billings, Montana. However, if CBNG development occurs on the Crow Reservation, workers from Wyoming would enter the Reservation.

Northern Cheyenne Reservation

Alternative H would likely result in similar impacts on the Northern Cheyenne Reservation related to population, employment and social conditions as identified under Alternative F. Like other Montana residents, unless Northern Cheyenne tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill the jobs created by Alternative F. Some off-site members may be encouraged by perceived job opportunities to return to the Reservation, which could increase demand for public services. Some tribe members are concerned that increased stress caused by social changes due to CBNG development may also increase the likelihood of alcoholism, drug abuse and family violence.

Alternative H includes a Native American Concerns screen that would protect groundwater and air resources and would require monitoring of federal CBNG development within 5 miles of the Northern Cheyenne Reservation. These requirements would protect ITAs and include site-specific groundwater and air quality analysis. This analysis would be included in the operator's Plan of Development. Indian Trust Assets (ITAs) would be protected from federal CBNG wells located within 5 miles of the Northern Cheyenne Reservation and if analysis showed that ITAs would be adversely affected, then BLM would consult with the tribe and determine appropriate mitigation measures which may include not approving the APD. BLM would require groundwater and air monitoring between the federal well field development area and the Reservation. If this monitoring indicates ITAs are not being protected, then the wells would be shut in.

Like the other alternatives, CBNG operators and subcontractors under Alternative H may need to drive across the Northern Cheyenne Reservation in order to reach some well sites in the northern part of the Planning Area (Rosebud County). Although the number of wells to be developed north of the Northern Cheyenne Reservation is relatively small, limited traffic, noise, safety and road maintenance impacts could occur on the reservation. The Northern Cheyenne are concerned that this would increase tribal member contact with outsiders, increasing the negative effects of social change described above. However, there is little reason for CBNG workers to stop on the reservation, as few services are offered on the reservation routes that would be used. Interaction with commuting workers would be of short duration and sporadic.

Conclusions

Social and economic impacts, such as employment, income, demographic migration, taxes, changes in lifestyle and social conditions would likely be similar to Alternative F. Like the other alternatives, new jobs would likely be filled by CBNG workers from Wyoming. Depending on limitations set by the four resource screens and watershed-level analysis, CBNG development could be relatively steady over the development period, provided development continues and the demand for natural gas remains. Under Alternatives B through E, CBNG development would increase rapidly, peaking over a 5-year period and then decrease over the remainder of the development period.

The social and economic impacts are likely to vary slightly from the other alternatives because development would occur based on watersheds, which may further spread CBNG development outside the three main counties most affected under Alternatives B through E (Big Horn, Powder River and Rosebud). This may reduce the overall impacts on social conditions and lifestyles.

The cumulative reduction in federal royalties due to the 5-mile buffer development delay/restriction around

reservations would result in a $1.2 billion loss to the federal government at current gas prices.

Cumulative water resource impacts from Alternative H would be less than Alternative C and E and more than Alternative B.

Environmental Justice

Environmental Justice *Executive Order 12898 requires the non-discriminatory treatment of minority and low-income populations for projects under the jurisdiction of a federal agency*
Alternative A **No Action (Existing CBNG Management)**
• Few adverse impacts with the exception of the undetermined Wyoming discharge influence.
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• The influence of Wyoming's discharge on Montana rivers would constitute a potential environmental justice issue if unresolved.
Alternative C **Emphasize CBNG Development**
• Same as Alternative B except for adverse environmental effects would be expected from downstream water quality changes resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• No adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative.
Alternative F **Phased Development Multiple Screens (High Range)**
• With mitigation, no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative E. • Project Plan and watershed-level analysis requirements would help to mitigate potential impacts.
• Project Plan consultation with tribes and on-going monitoring for developments within 5 miles of a Reservation would help to protect Indian Trust Assets.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be less than other development alternatives due to fewer federal wells being developed. • With mitigation, no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B. • Project Plan and watershed-level analysis requirements would help to mitigate potential impacts. • Project Plan consultation with tribes and on-going monitoring for developments within 5 miles of a Reservation would help to protect Indian Trust Assets.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts would be similar to Alternative F due to similar number of wells developed. With mitigation, no adverse human health or environmental effects would be expected to fall disproportionately on minority or low-income populations from this alternative. Wyoming Discharge issues same as Alternative B. • Project Plan, resource screens and watershed-level analysis requirements would help to mitigate potential impacts. • Project Plan consultation with tribes and on-going monitoring for developments within 5 miles of a Reservation would help to protect Indian Trust Assets.

Assumptions

The purpose of this analysis is to report whether high and adverse human health or environmental effects of the proposed alternatives are likely to fall disproportionately on minority or low-income populations. This analysis focuses on the populations that are located within the areas potentially affected by the alternatives. It examines where expected high and adverse impacts, if any, fall relative to minority and low-income populations. In order to make a finding that a proposed project is inconsistent with the Environmental Justice policy established in Executive Order (EO) 12898 and described in Section 4.10.1.7, two situations must occur at the same time: 1) there must be a minority or low-income population; and 2) that population must receive a disproportionately high and adverse environmental or human health impact.

Two options are considered depending on what the impacts are:

- If adverse impacts are identified in the resource analyses, the individual occurrence potential is

analyzed for disproportionate effects on minority and/or low-income populations.

- If no adverse impacts are identified in the resource analyses, then no environmental justice issues would be expected as a result of the alternative. Therefore, it can be concluded that no adverse human health or environmental effects would fall disproportionately on minority or low-income populations. Consequently, none of the impacts of the alternative can be described as having a high and adverse impact in the context of EO 12898. The proposed alternatives are therefore consistent with the policy established in EO 12898.

Scoping comments indicated that analysis from the Economic, Social and Cultural Supplement to the Powder River I Regional EIS (BLM 1989) was relevant to the analysis of impacts to the reservations. The analysis found that although coal development activities would be off-reservation, economic, social and cultural impacts could occur on the reservation. Economic and social impacts would occur primarily due to tribal members moving back to the reservation to seek employment and people living off-reservation coming to the reservation to seek recreation and services. Impacts identified by the supplement included increased demand for services such as housing, water, health services, education and emergency services, as well as increased stress associated with social change potentially leading to increases in alcoholism, drug abuse, family violence, crime and feelings of deprivation because the reservation would receive negative impacts, but few benefits, from regional coal development.

This type of effect is not expected to occur because, unlike the development of coal, which employs many Montana workers, CBNG development would not provide many employment opportunities for people in Montana. Most of the jobs would be filled by workers currently employed by the CBNG industry based in Wyoming. These workers would have little to no affect on the reservation because they will not be driving across it on a routine basis. Similar to other Montana residents, unless tribal members are already working in the CBNG industry out of Wyoming, it is unlikely that tribal members would fill the jobs created by the alternatives. In addition, the area of high interest for CBNG is located further away from the Northern Cheyenne Reservation than some of the possible coal mines projected in the 1989 Coal SEIS.

In addition to the concern listed above, the increased need for coordination and interaction with local, state and federal governments is a concern for tribal resources. See the *Indian Trust and Native American Concerns* section in this chapter for further discussion of cultural impacts.

Impacts from Management Common to All Alternatives

Social and Economics Values

Although none of the alternatives propose CBNG development on the reservations, the Crow and Northern Cheyenne tribes could be affected by increases in noise, impacts on visual resources and plant populations, etc., in particular, as these affect locations and resources used for spiritual or religious purposes.

It is expected that development will occur first within the southern portion of the Planning Area; this is where CBNG development is currently occurring within the CX Ranch Field. CBNG workers that come from Sheridan or Gillette in Wyoming to develop wells within the southern portion of the Planning Area will not cross the Northern Cheyenne or Crow Reservations on their journey to work.

When the wells to the north are developed, CBNG workers may need to drive across the Northern Cheyenne Reservation to reach some of those sites. Although the number of wells to be developed north of the Northern Cheyenne Reservation is relatively small, limited traffic, noise, safety and road maintenance impacts on the reservation could occur. The Northern Cheyenne are concerned that this would increase tribal member contact with outsiders, increasing the negative effects of social change described above. However, as with any of the alternatives, there would be little reason for CBNG workers to stop on the reservation, as few services are offered on the reservation routes that would be used. Interaction with commuting workers is not expected

CBNG workers needing to travel from Sheridan or Gillette to the relatively small number of potential CBNG sites in the western part of the Planning Area would likely drive across the Crow Reservation on I-90. Because this is a heavily traveled interstate, the incremental increase in traffic would not adversely affect the Crow Reservation.

There is a small Amish community in Rosebud County that may be a low-income population. Well development under any of the alternatives would adversely affect this community if well sites are located nearby. However, with the measures to mitigate effects on groundwater and other measures to reduce effects, CBNG development is not expected to have disproportionately high and adverse effects on this community.

Under management common to all alternatives, the EO and BLM policy guidance would continue to provide for minority participation in future BLM management decisions.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Areas that require further analysis for disproportionate effects to minorities or low-income populations include water quality (potential impact of CBNG-produced waters being discharged into the Little Bighorn River and the Tongue River Reservoir from Wyoming CBNG activities) and social and economic effects. See discussions below.

Water Quality

Crow Reservation

The Little Bighorn River, which originates in Wyoming and flows onto the Crow Reservation, could experience impacts to its water quality. The changes in water quality would be dependent upon the terms of the Final Water Quality Agreement signed between Montana and Wyoming. The current interim agreement does not address the Little Bighorn watershed. Impacts could range from a negligible effect to a modest increase in SAR, TDS, EC and bicarbonate. If the agreement allows for some CBNG-produced water to be discharged into the Little Bighorn River, the resulting downstream water would increase SAR, EC, TDS and bicarbonate, thus the tribe's beneficial use of that water may be diminished, as well as the tribe's ability to market their water as a commodity. No health effects are foreseen from the change in water quality or the consumption of downstream fish present in the Little Bighorn River.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne's Water Right in the Tongue River Reservoir would be the result of Wyoming allowing CBNG-produced waters to be discharged into the Tongue River, altering the water quality of the reservoir. The range of water quality changes would be dependent upon the Final Water Quality Agreement between Montana and Wyoming. Current policy in Wyoming is that there would be no discharge of CBNG-produced water into the Tongue River. The scenarios for possible impact ranges are described in detail in the Hydrological Resources section of this chapter. Worth mentioning though, is that even a slight change in water quality to the reservoir could impact the Northern Cheyenne's ability to market their water as a commodity and reduce their own beneficial uses.

Social and Economic Values

The same social and economic effects listed under *Impacts from Management Common to All Alternatives* could occur under Alternative A. However, there would be fewer CBNG workers driving across the reservation than for Alternatives B thru H; thus, the potential traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be less.

Conclusion

The potential impacts to the surface water concerns of both tribes would be somewhat alleviated by their participation in the state-to-state discussions regarding the Water Quality Agreement. If either tribe were to obtain self-governance over their water quality, they could act with the authority of a state and set their own water quality or non-degradation standards and negotiate with Wyoming for an altered agreement more in line with their specific needs and concerns. Currently, the Northern Cheyenne are working with the EPA to adopt draft water quality standards and obtain primacy for their surface water. The lower number of jobs associated with this alternative would lead to fewer people driving across the reservations.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

A review of the resource analyses conducted for Alternative B identifies the following impacts that warrant further review for disproportionate effects on minority or low-income populations. The impacts included in this evaluation are the drawdown of groundwater; air quality changes; changes to vegetation and soils; and social and economic values.

Groundwater Drawdown

CBNG production in Montana would result in the depletion of an estimated 23 percent (ALL 2001b) of the groundwater resources in the productive coal seams beneath Montana's Powder River Basin. This drawdown would be basinwide and correspond to the geographical distribution of production wells. The occurrence potential is not localized and would not impact segregated portions of the population; the impact would be felt evenly across the region. Furthermore, the drawdown has the potential to reduce surface water flows in some drainages depending on specific site conditions. The availability of groundwater is important, as many rural families

depend on the supply of groundwater for their household and ranch/agricultural (irrigation) applications.

Air Quality Changes

CBNG development in the Powder River Basin would necessitate the construction of minor emission sources spread out over a very large area. The air quality modeling shows potential air quality impacts at downwind mandatory Federal PSD Class I areas and that other "sensitive receptors" would exceed the PSD Class I NO_2 increment; cause nitrate and sulfate atmospheric deposition (and their related impacts) in sensitive lakes; and cause perceptible visibility impacts (regional haze). Additionally, there is the potential for the NAAQS to be exceeded for NOx in the Spring Creek Coal Mine area. However, it should be noted that these findings are representative of the maximum potential air quality impacts.

Generally, the potential changes in air quality from development would be within acceptable limits, widespread and distributed across the region. The impacts associated with the dispersion of air pollutants across the region would not be disproportionately distributed upon any minority or low-income groups.

Crow Reservation

Under this alternative, a 2-mile buffer zone would be enforced on federal mineral development around the reservation to restrict development of minerals adjacent to these boundaries. This buffer zone would delay some of the groundwater drawdown impact associated with federal pumping but would not prevent state and private mineral estates from being developed adjacent to the reservation. Therefore, drawdown could affect Indian populations within the Crow Reservation adjacent to off-reservation development.

The Crow tribal government derives some of its income from operator lease fees: ranchers and irrigators operating both on private and reservation lands. If these operators were to experience a reduction in available groundwater that impacted their operations and the Crow Tribe subsequently had to reduce their fees, the tribe would lose a portion of their income. Trust agencies might be needed to resolve conflicts. The form of resolution most desirable would be the replacement of water resources and the according adjustment in fees. If the replacement of water resources could not be achieved because of site-specific conditions or other variables, the loss in potential income generation from reduced fees and limited new private opportunities would have to be made up for or this could be an environmental justice issue.

Northern Cheyenne Reservation

The Northern Cheyenne Tribe would experience similar groundwater drawdown and potential operator lease private issues as discussed under the Crow Reservation section above.

As described under the above Air Quality Changes section, the air quality modeling shows potential air quality impacts at downwind mandatory Federal PSD Class I areas and the Northern Cheyenne's PSD Class I area, as well as causing a small increase in perceptible visibility impacts (regional haze). However, these findings are representative of the maximum potential air quality impacts.

Social and Economic Values

The same social and economic effects listed under *Impacts from Management Common to All Alternatives* could occur under Alternative B. There would be more CBNG workers driving across the reservations to reach well sites due to the larger number of wells to be developed; thus, the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be more than Alternative A, but are not expected to be substantial, as described in *Impacts from Management Common to All Alternatives*. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Conclusions

If the Northern Cheyenne and Crow tribes elected to develop their CBNG resources the federal buffer zone would not be used to limit the effect on the reservation. An additional percentage of drawdown would be experienced across the basin watersheds from the Northern Cheyenne and Crow tribal developments (see Hydrological Resources section for details). If the tribe's CBNG resources were drilled to the degree estimated in the RFFA (4,000 wells for each reservation), the depletion of the coal seam aquifer groundwater resource could increase across the region and cause a hardship on numerous low-income and minority populations, which are prevalent throughout the area. However, water well and spring mitigation agreements required by the MBOGC, BLM and TLMD would provide alternate sources of water due to groundwater lost to the drawdown of resources within the coal seam aquifers. Drawdown in non-producing coal seams aquifers is not anticipated. Replacement may not be possible in some areas with concentrated CBNG production. This represents a possible environmental justice issue if the non-replacement

areas are adjacent to reservation boundaries and no suitable water is available for mitigation.

No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana rivers would constitute a potential environmental justice issue if unresolved. Social and economic effects on the Crow and Northern Cheyenne tribes under this alternative would be more than Alternative A, but are not expected to be substantial.

Alternative C—Emphasize CBNG Development

The resource analyses performed for Alternative C indicate that groundwater drawdown, social and economic values and changes to the surface water quality and the subsequent impacts on vegetation, wildlife and aquatic resources would have effects that warrant further review for disproportionate effects on minority or low-income populations.

Groundwater Drawdown

The drawdown of groundwater within the Powder River Basin would have greater effects than described under Alternative B. Without the federal development buffer zone around reservations, drawdown effects could be amplified and appear sooner on reservation properties than under Alternative B.

Surface Water Quality

Under Alternative C, the quality and quantity of surface waters in the Powder River Basin could be altered depending on the outcome of the statewide water quality standards. The MDEQ is in the process of setting statewide water quality standards that would likely include the framework for managing surface discharge of CBNG-produced water throughout the state. The watersheds would most likely experience increases in SAR values, sedimentation, TDS and a marginal increase in base flow as described in the Hydrological Resources section of this chapter. Based on SAR values, the addition of untreated CBNG-produced waters with high SAR values under the least restrictive extreme criteria would not exceed an SAR value of 12. High-quality watersheds in the FSEIS Planning Area would have adequate assimilative capacity to accept expected discharges from full-scale development of CBNG. All other watersheds should only experience a slight increase in SAR, which would remain below the suggested not to exceed a value of 3 for some soils and possibly as high as 12 for others.

It is assumed that the sodium content of produced CBNG water is the target contaminant that determines the usefulness of the water for crop irrigation. Irrigation uses the majority of water resources in those watersheds thought to have the greatest potential for CBNG development. Sodium causes osmotic stress to plants and destroys the texture of clayey soils; these combined effects make sodium content and especially SAR, a point of emphasis when gauging impacts to water resources from CBNG water. Other parameters such as TDS, nitrogen and barium concentration may be locally important in determining restrictions to beneficial use. It is assumed that discharge to high-quality watersheds would be limited during the irrigation season and managed on a flow-based discharge scenario. Under these circumstances, high-quality watersheds in the FSEIS Planning Area would have sufficient capacity to meet the current irrigation needs. Flow-based discharge would however, require additional storage of produced water during the irrigation season for later discharge when stream flows are less sensitive to being impacted by produced water discharges.

The consequential downstream effects of increased SAR and base flow would result in the erosion of riparian areas along rivers, the reduction of both vegetation and wildlife habitat and the impairment of fish populations. These consequential effects are mentioned because of the large number of Native Americans who have a traditional reliance on the natural agriculture for sacred plants used in medicines and for their hunting and fishing way of life. If these combined water quality impacts are realized, there could be a disproportionate effect felt by the Native Americans as it reduces their ability to gather sacred plants and limit their hunting and fishing opportunities. A large percentage of the population in Big Horn (61 percent) and Rosebud (33 percent) counties are Native Americans and constitutes a sizeable minority population within the FSEIS Planning Area.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts projected for the FSEIS Planning Area. The reservation can expect impacts to Bighorn, Little Bighorn, Rosebud and Squirrel Creek watersheds, such as increased flow volume, changes to water quality parameters, including SAR, EC and bicarbonate. The Crow Tribe could experience drawdown of groundwater in coal seam aquifers from Wyoming and Montana CBNG production. The traditional pattern of natural resource consumption would be altered and therefore impacts to sacred plants and hunting and fishing are expected.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation are expected to be similar to impacts projected for the FSEIS Planning Area. The Northern Cheyenne Reservation could experience impacts to the Tongue River and Rosebud Creek in the form of increased flow volume and changes to water quality parameters, including SAR, EC and bicarbonate. The reservation could also experience drawdown of coal seam aquifers from CBNG production in the area surrounding the reservation. The traditional pattern of natural resource consumption would be altered and therefore impacts to sacred plants and hunting and fishing are expected.

Social and Economic Values

The same social and economic effects listed under Impacts from Management Common to All Alternatives could occur under Alternative C. The number of CBNG workers driving across the reservations to reach well sites would be similar to Alternative B; thus, the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be similar.

Conclusions

These surface water quality and quantity effects, when combined with the increases projected from similar current and planned CBNG development activities in Wyoming, would further increase the SAR value, base flow and other potential constituents of concern in the, Powder and Little Powder rivers. The combined decrease in water quality would necessitate the use of flow-based discharge to avoid limiting the resource for use as a source of irrigation. The resulting impacts may still impair tribal government leasing activities. This could create an environmental justice issue to tribes as described under Alternative B.

No adverse human health impacts are foreseen from these environmental changes. The influence of Wyoming's discharge on Montana rivers would constitute a potential environmental justice issue if unresolved. It is concluded that adverse environmental effects could occur from downstream water quality changes, resulting in limitations to subsistence living styles. These limitations would fall disproportionately on minority or low-income populations from this alternative.

Social and economic effects on the Crow and Northern Cheyenne tribes under this alternative would be similar to Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Air Quality, Surface Water Quality and Groundwater Drawdown

A review of the resource analyses for Alternative D revealed that similar potential effects would be felt as described under Alternative B for groundwater drawdown and air quality changes and under Alternative C for surface water quality but at a reduced impact because of water treatment and discharge conveyance. The same trickle-down effects would be experienced under Alternative D as described in Alternative C but, again, at a reduced level because of water treatment.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts described under Alternative C with the exception of Montana CBNG surface water quality impacts. Surface water impacts would be limited to changes due to increased quantity of surface discharge but treatment prior to discharge would reduce impacts to water quality compared to Alternative C. Groundwater impacts would be the same as Alternative B.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation would be similar to impacts described under Alternative C with the exception of Montana CBNG surface water quality impacts. Surface water impacts to the Tongue River and Rosebud Creek would result from increases in quantity of surface discharge but treatment prior to discharge could reduce impacts to water quality. Groundwater impacts would be the same as Alternative C.

Social and Economic Values

The same social and economic effects listed under Impacts from Management Common to All Alternatives could occur under Alternative D. The number of CBNG workers driving across the reservations to reach CBNG sites would be similar to Alternatives B and C, thus the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be similar. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Conclusions

The surface water quantity effects, when combined with the increases projected from similar current and planned CBNG development activities in Wyoming, would be less than those described in Alternative C because of the treatment of discharge water. Water would be available for irrigators and tribal government leasing activities and would not be impaired. The drawdown of groundwater and subsequent availability would be as described in Alternative B. If the Northern Cheyenne and Crow Tribes elected to develop their CBNG resources, impacts would occur as described under Alternative B.

Social and economic effects on the Crow and Northern Cheyenne Tribes under this alternative would be similar to Alternatives B and C.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Air Quality, Surface Water Quality and Groundwater Drawdown

The impact analyses for Alternative E shows that impacts on surface water quality would be slightly altered; however, downstream uses would not be diminished nor would the State's water quality standards be exceeded. Alternative E stresses the beneficial uses of produced water from CBNG wells and requires a Water Management Plan be developed that demonstrates how an operator can discharge without degrading the surface water quality before any discharge can occur. Similar potential effects would occur as described under Alternative B for groundwater drawdown and air quality changes.

Crow Reservation

Impacts on the Crow Reservation are expected to be similar to impacts projected for the region under Alternative E with the exception of groundwater impacts. Operators are required to conduct site-specific hydrological studies prior to APD approval. If the site-specific studies determine there would be an effect to Reservation groundwater, the operator must develop and apply measures to prevent the impact of groundwater withdrawal and monitor the effectiveness of such measures. These measures would be approved by BLM in consultation with the tribe. Furthermore, operators must modify federal CBNG production if production is resulting in an effect on groundwater or CBNG on the Reservation. BLM requirements could include reducing production rates, shutting in the well or wells, or providing compensation to the tribe. The operator must correct the impact of groundwater withdrawal prior to resuming full production.

For lands under the jurisdiction of the State, the operator would be required to follow recommendations in the Technical Advisory Committee's guidance document for meeting the requirements of the MBOGC Order No. 99-99. The order requires an evaluation of pre-development groundwater conditions, plus monitoring and evaluations, including procedures for monitoring and reporting the effects of CBNG development on water users. Based on the implementation of these measures tribal groundwater resources would be protected and potential impacts eliminated.

Northern Cheyenne

Impacts on the Northern Cheyenne Reservation are expected to be similar to impacts projected for the region under Alternative E with the exception of groundwater impacts. Operators are required to conduct site-specific hydrological studies prior to APD approval. If the site-specific studies determine there would be an effect to Reservation groundwater, the operator must develop and apply measures to prevent the impact of groundwater withdrawal and monitor the effectiveness of such measures. These measures would be approved by BLM in consultation with the tribe. Furthermore, operators must modify federal CBNG production if monitoring shows production is resulting in an effect to groundwater or CBNG on the Reservation. BLM requirements could include reducing production rates, shutting in the well or wells, or providing compensation to the tribe. The operator must correct the impact of groundwater withdrawal prior to resuming full production.

For lands under the jurisdiction of the State, the operator would be required to follow recommendations in the TAC guidance document for meeting the requirements of the MBOGC Order No. 99-99. The order requires an evaluation of pre-development groundwater conditions, plus monitoring and evaluations, including procedures for monitoring and reporting the effects of CBNG development on water users. Based on the implementation of these measures, tribal groundwater resources would be protected and potential impacts eliminated.

Surface water impacts on the Tongue River and Rosebud Creek would also be reduced. The surface water quality in these two waterbodies would be slightly altered; however, downstream uses would not be diminished nor would the proposed Northern Cheyenne water quality standards be exceeded.

With regards to air quality, operators would be required to provide the information necessary for BLM to conduct an analysis of air quality impacts for all relevant parameters when submitting their exploration APDs or field development project plans. BLM would use the information to determine the individual and cumulative impact on the reservations' air quality, disclose the analysis results in the appropriate NEPA document and consult with the tribes when the analysis shows impacts from a specific drilling or development proposal.

Approval of exploration APDs and field development plans and the air quality new source review process would include conditions to prevent violations of applicable air quality laws, regulations and standards. Mitigating measures may include surfacing roads and well locations, applying dust suppressants, requiring operators to develop and enforce speed limits on project roads, minimizing construction of roads, requiring use of natural gas-fired and electric compressors and optimizing the number of wells connected to one compressor.

Operators near the Reservation may be required to restrict the timing or location of CBNG development if monitoring or modeling by the air quality regulatory authority finds their CBNG development is causing or threatening to cause non-compliance with applicable local, state, tribal and federal air quality laws, regulations, standards and implementation plans.

To protect important hunting, fishing and plant gathering sites, the BLM would require operators in the area east of the Tongue River between Ashland and Birney to inventory BLM-administered surfaces for traditional plant gathering sites near the proposed drilling locations. APD approvals may include avoidance or timing restrictions to prevent impacts to identified important hunting, fishing and plant gathering sites depending on the developments' location. These measures would prevent potential impacts to subsistence living methods for tribal members. Migratory paths traditionally used by game to cross the Northern Cheyenne Reservation would be monitored as part of the Wildlife Monitoring and Protection Plan. If these impacts to migration routes result in a reduction of available game measures would be developed in consultation with the tribe to provide for wildlife migration.

Social and Economic Values

The same social and economic effects listed under *Impacts from Management Common to All Alternatives* could occur under Alternative E. The number of CBNG workers driving across the reservations to reach well sites would be similar to Alternatives B, C and D; thus, the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be similar. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Conclusions

These surface water quality and quantity effects, when combined with the increases projected from similar current and planned CBNG development activities in Wyoming, would be less than those described in Alternative C. Water would be available for irrigators and tribal government water leasing activities would not be impaired. The groundwater would be protected as described in the Northern Cheyenne Mitigation Appendix.

If the Northern Cheyenne and Crow tribes elected to develop their CBNG resources, impacts as described under Alternative B above would occur.

Social and economic effects on the Crow and Northern Cheyenne tribes under this alternative would be similar to Alternatives B, C and D.

Alternative F—Phased Development Multiple Screens (High Range)

Air Quality Changes

Review of the air resource analysis indicated that Alternative F would have impacts on air quality similar, but less than Alternative E. The sources of CBNG generated emissions would be minor and widespread under Alternative F, particularly since development would be limited within any given watershed. There would be a more dispersed pattern of development across the region, thus the emissions would be less concentrated and more apt to disperse with little effect on human health and thus on environmental justice populations.

Groundwater Drawdown

Potential effects on groundwater drawdown would be similar to Alternatives B through E. Under Alternative F, federal APDs would be more dispersed throughout the region and limited in a given watershed in any given year. Thus, groundwater drawdown would not likely be concentrated in any one area and affect low income or minority populations.

Surface Water Quality

Surface water quality impacts under Alternative F would be similar or less than those described under Alternative E. While some discharge of untreated

water would be allowed, the volume would be limited to 10 percent of the 7Q10. If volumes exceed the allowable amount per watershed, then any additional federally produced water would be required to be injected, treated (including using impoundments), or put to a beneficial use.

Social and Economic Values

The same social and economic effects listed under *Impacts from Management Common to All Alternatives* could occur under Alternative F. The number of CBNG workers driving across the reservations to reach well sites would be less than Alternatives B through E and similar to Alternative H because of phased development; thus, the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be similar. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Avoidance and Mitigation Measures

In addition to the enhanced mitigation requirements listed for Alternative E that include conducting site-specific hydrological studies, development of mitigation measures, monitoring techniques for water and air quality and POD preparation prior to APD approval, Alternative F would extend these requirements to any areas within 5 miles of the Reservation.

The analysis and monitoring data would be required to demonstrate that Indian Trust Assets on the Crow and Northern Cheyenne Reservations would not be affected by development of federal CBNG wells. If the analysis does not show protection of these assets, the BLM would hold tribal consultations to determine appropriate mitigation measures, which may include denying the APDs.

The potential loss of royalties to the Federal government from a 5-mile buffer would be approximately $1.2 billion at current gas prices.

Monitoring wells and air monitoring stations may be required between the well development area and the reservations to ensure protection of reservation air and groundwater resources. If monitoring indicates impacts to ITAs on the Crow and Northern Cheyenne reservations, wells would be shut in. If CBNG development occurs on a reservation, this monitoring requirement may be modified in consultation with the tribes and other affected parties. Thus, Alternative F would be less likely than Alternative E to affect environmental justice populations, given the CBNG development requirements for resource analysis, mitigation and monitoring.

Implementation of the wildlife screen could lead to a situation where no CBNG development would occur within crucial sage-grouse habitat. This would lead to a loss of royalties to the Federal government of approximately $290 million at current gas prices.

Conclusions

Surface water quality and quantity impacts when combined with undesirable effects from CBNG development in Wyoming would be less than those described under Alternative E. Generally, groundwater would be protected and impacts to ground and surface water quality/quantity would be limited.

Social and economic effects on the Crow and Northern Cheyenne Tribes under this alternative would be similar to Alternatives B through E.

Overall there is likely to be limited impacts on low income or minority populations under Alternative F. If the Crow and Northern Cheyenne tribes decided to develop their CBNG resources, potential impacts would occur as described under Alternative B.

Alternative G—Phased Development Multiple Screens (Low Range)

Air Quality, Surface Water Quality and Groundwater Drawdown

Air quality, groundwater drawdown, surface water quality and social and economic impacts would be similar to Alternative F; however, the magnitude of the impacts would be greatly reduced because of the lower number of wells that would be developed (approximately 65 percent fewer wells). Some watersheds would still experience more well development than other watersheds, but compared to Alternative F, the level of impact across the watersheds would be less under Alternative G. Since Alternative F is not anticipated to impact environmental justice populations, Alternative G also would have little effect on these populations.

Social and Economic Values

The same social and economic effects listed under Impacts from Management Common to All Alternatives could occur under Alternative G. This alternative would employ fewer workers because of the reduced number of wells that would be developed under Alternative G. This may result in fewer CBNG workers driving across the Northern Cheyenne Reservation than under Alternatives B thru E and F

and H, thus the traffic, noise, safety, road maintenance and worker interaction impacts on the reservation would be less. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Avoidance and Mitigation Measures

Mitigation measures for well development on or in close proximity (within 5 miles) to the reservations would be the same as for Alternative F. However, due to the reduced number of wells that would be developed under this alternative, the potential loss of royalties to the Federal government from a 5-mile buffer would be about 65 percent less than for Alternative F (approximately $420 million).

Conclusions

While air quality, groundwater drawdown and surface water quality impacts would be similar to Alternative F, the magnitude of these impacts would be greatly reduced under this alternative, due to significantly less well development.

Social and economic effects on the Crow and Northern Cheyenne tribes under this alternative would be similar to but less than Alternatives B through F.

Alternative H—Preferred Alternative - Multiple Screens

Air Quality Changes

Review of the air resource analysis indicated that Alternative H would have impacts on air quality similar to Alternative F. The sources of CBNG generated emissions would be minor and widespread under Alternative H, particularly since development would be limited within any given watershed. There would be a more dispersed pattern of development across the region, thus the emissions would be less concentrated and more apt to disperse with little effect on human health and thus on environmental justice populations.

Groundwater Drawdown

CBNG production in Montana would result in the depletion of approximately 23 percent of the groundwater resources in the productive coal seams beneath Montana's Powder River Basin (ALL 2001b). This drawdown would be basinwide and correspond to the geographical distribution of production wells. By implementing watershed-level analysis, water management planning and water balance projections as part of PODs, federal CBNG well development under Alternative H would be more dispersed throughout the region and limited in a given watershed in any given year as compared to Alternatives B through E.

As for the other development alternatives, the occurrence potential is not localized and would not impact segregated portions of the population; the impact would be felt evenly across the region. Furthermore, the drawdown has the potential to reduce surface water flows in some drainages depending on specific site conditions. The availability of groundwater is important, as many rural families depend on the supply of groundwater for their household and ranch/agricultural (irrigation) applications.

Surface Water Quality

Due to the water screen, Alternative H would have impacts on water resources and water resource values similar to or less than the other development alternatives. This alternative would allow limited discharge of untreated water under certain conditions. The volume of discharge from federal wells would be based on 10 percent limit of the 7Q10 flow calculated from all CBNG wells at the downstream end of the watershed. The 10 percent would not apply if surface water monitoring is being conducted above and below the proposed outfalls. If surface water monitoring indicates a water quality threshold would be exceeded, no further untreated discharge would be allowed from federal wells upstream from the station. Previously approved water management plans may be modified or rescinded if monitoring indicates unacceptable impacts are occurring. Water quality thresholds and the surface water monitoring requirements are detailed in the Hydrology Appendix. If volumes exceed the allowable amount per watershed, then any additional federally produced water would be required to be injected, treated (including using impoundments), or put to a beneficial use.

Social and Economic Values

The same social and economic effects listed under Impacts from Management Common to All Alternatives could occur under Alternative H. The number of CBNG workers driving across the reservations to reach well sites would be less than Alternatives B through E and similar to Alternative F because of phased development; thus, the traffic, noise, safety, road maintenance and worker interaction impacts on the Northern Cheyenne Reservation would be similar. To reduce effects of speeding vehicles, operators of federal leases would be required to post and enforce speed limits on their employees, or employees of their contractors.

Avoidance and Mitigation Measures

Alternative H incorporates the enhanced mitigation requirements from Alternative F, which include conducting site-specific hydrological studies, development of mitigation measures, monitoring techniques for water and air quality, watershed-level analysis and additional air and groundwater analysis and tribal consultation for development proposed within 5 miles of the Crow or Northern Cheyenne reservations. Alternative H would also require the BLM to use the four resource screens, including air quality and Native American concerns, to evaluate PODs and on-going development prior to approval of additional APDs.

Within 5 miles of either reservation, analysis and monitoring data would have to demonstrate how ITAs on the Crow and Northern Cheyenne reservations would be affected from development of federal CBNG wells. If the analysis does not show protection of these assets, the BLM would hold tribal consultations to determine appropriate mitigation measures, which may include denying the APDs.

The potential loss of royalties to the Federal government from a 5-mile buffer would be approximately $1.2 billion at current gas prices.

Monitoring wells and air monitoring stations may be required to be installed between the well development area and the reservations. If monitoring indicates that Trust Assets on the Crow and Northern Cheyenne reservations are not being protected, wells would be shut in. If CBNG development occurs on a reservation, this monitoring requirement may be modified in consultation with the tribe and other affected parties. Thus, Alternative H would be less likely than Alternative E to affect environmental justice populations given the CBNG development requirements for resource analysis, mitigation and monitoring.

If no development were to occur within crucial sage-grouse habitat, then the socio-economic effect would be similar to that described under Alternative F.

Conclusions

Surface water quality and quantity impacts, when combined with undesirable effects from CBNG development in Wyoming, would be less than those described under Alternative E. Generally, groundwater would be protected and impacts to ground and surface water quality/quantity would be limited. Social and economic effects on the Crow and Northern Cheyenne Tribes under this alternative would be similar to Alternatives B through F.

If either the Northern Cheyenne Tribe or Crow Tribe elects to develop their CBNG resources, the federal 5-mile buffer zone would not be used to limit the effect on the reservation. An additional percentage of drawdown would be experienced across the basin watersheds from the Northern Cheyenne or Crow tribal developments (see *Hydrological Resources* section for details). If each tribe's CBNG resources were drilled to the degree estimated in the RFFA (4,000 wells for each reservation), the depletion of the coal seam aquifer groundwater resource could increase across the region and cause a hardship on numerous low-income and minority populations, which are prevalent throughout the area. However, water well and spring mitigation agreements required by the MBOGC, BLM and TLMD would provide alternate sources of water due to groundwater lost to the drawdown of resources within the coal seam aquifers. Drawdown in non-producing coal seam aquifers is not anticipated. Replacement may not be possible in some areas with concentrated CBNG production. This represents a possible environmental justice issue if the non-replacement areas are adjacent to reservation boundaries and no suitable water is available for mitigation.

Soils

Soils *Montana has a wide mix of geologic parent material, which produces a vast array of different soil types*
Alternative A **No Action (Existing CBNG Management)**
• There would be minor occurrences of soil erosion, runoff and sedimentation, mostly during construction activities. • Approximately 1,500 acres would be disturbed short term during CBNG exploration and construction activities. • 500 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased.
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• CBNG development would result in 55,400 acres being disturbed. • 32,950 acres would be disturbed longer term during production, with a majority of the land reclaimed after production is ceased. • No impacts would occur to soils from CBNG waters.
Alternative C **Emphasize CBNG Development**
• CBNG development activities would disturb 70,000 acres. • Surface discharge and irrigation of produced water could result in detrimental impacts to soils.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• Impacts would be similar to Alternative B with the exception that produced water would be treated prior to discharge and not injected. • More water would be available for irrigation of agricultural land.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• Impacts would be similar to Alternative B. There would be a slight increase in the level of disturbance due to the increased use of impoundments to contain produced water. • Produced water would be available for beneficial use, including irrigation.
Alternative F **Phased Development Multiple Screens (High Range)**
• Impacts would be similar to Alternative E, although some impacts would not occur or be delayed due to the implementation of cumulative and watershed specific numerical limits on the number of federal CBNG APDs approved per year. • Produced water would be available for beneficial use, including irrigation • CBNG development would result in approximately 55,150 acres being disturbed. If no development occurs within the crucial sage-grouse habitat, then approximately 48,091 acres of disturbance would occur. • An estimated 32,850 acres would be disturbed longer term during production, with a majority of the land reclaimed after production has ceased. Alternatively, if development does not occur in crucial sage-grouse habitat, then the acres of long-term disturbance is reduced to 28,645.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to Alternative F, although impacts would be about 65 percent less due to the limit on the number of federal CBNG APDs (323 versus 910) approved per year. • Produced water would be available for beneficial use, including irrigation
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts to soils would be similar to Alternative F. • CBNG development would result in approximately 55,150 acres being disturbed. • An estimated 32,850 acres would be disturbed longer term during production, with a majority of the land reclaimed after production has ceased.

Assumptions

Surface disturbance assumptions are detailed in the *Analysis Assumptions and Guidelines* section of this chapter. This analysis is focused on the CBNG emphasis area, but can be used by inference on similar areas in Montana. A more detailed discussion of soils is presented in the *Soils Technical Report* (ALL 2001a).

Impacts From Management Common to All Alternatives

Impacts on soils would occur from various activities during the exploration, construction, operation and abandonment of conventional oil and gas wells developed resulting in a loss of either soil resources or soil productivity. These impacts would include soil compaction under disturbed areas such as well sites and lease access roads, soil erosion in disturbed areas and chemical impacts from spills of liquids. Some impacts would be unavoidable, such as those resulting from the construction of well sites. Other impacts would be mitigated by standard oil field practices, such as the use of berms around production facilities. Short-term impacts would occur typically during construction phases, including reclamation of construction sites.

Soils disturbed by the building of access roads, drill pads and pipelines would be prone to accelerated

erosion because of the removal of protective vegetation and litter cover during construction activities. This protective cover would bind the soil, provide desirable surface texture for infiltration of water and air and protect the surface from water and wind erosion. Accelerated soil erosion would occur during the production phase in high traffic areas of the well pad or along access roads or in portions of the well pad that have not been properly graded. In areas where soils have high to severe erosion potential and are unstable, disturbance would result in accelerated erosion to the extent that damage to facilities and roadways may occur. Wind and water erosion on bare soil surfaces would cause more sedimentation in streams from runoff following rainfall or snowmelt.

Impacts would be greatest on shallow soils of low productivity and on soils on moderately sloping to steep landscapes. Project activities would have minimal effect on slope stability because surface disturbance on slopes in excess of 30 percent would be avoided where possible. Where such disturbances cannot be avoided, mitigation measures required by MBOGC and BLM through the APD authorization process would be implemented to reduce erosion and protect watershed resources. BLM and TLMD lease stipulations would also be used to mitigate soil erosion. Eastern Montana suffers from excessive wind erosion primarily from dry soil, sparse vegetative cover and erodible soils.

Drilling activity-especially equipment transport-would cause soil compaction. The degree of compaction would be influenced by soil texture, moisture content, organic matter and soil structure. Soils with a mixture of sand, silt and clay compacts more than a soil with more uniform particle size. Coarse-textured sandy soils generally would be more compactable than fine-grained soils. Soil moisture would be the most critical factor in compaction. At field capacity, which is the amount of soil moisture remaining after a soil mass is saturated and allowed to drain freely for 24 hours, sufficient water remains in the pores to provide particle-to-particle lubrication and maximum compaction potential under load. Thus, moist but not wet soils would be most susceptible to compaction.

Organic matter such as roots and humus would help reduce soil compaction. In general, the greater the organic matter content, the less compaction. Compaction would severely affect plant growth by inhibiting root penetration, limiting oxygen and carbon dioxide exchange between the root zone and the atmosphere and severely limiting the rate of water infiltration into the soil. Compaction of soils would inhibit reclamation and natural revegetation of disturbed areas. Loss of topsoil and a decrease in soil productivity from soil layer mixing and compaction would impact the natural vegetation supported in the area, which in turn may affect forage and habitat for wildlife and livestock. The use of off-road vehicles and heavy equipment would cause soil compaction, which will lead to increased surface runoff and subsequent erosion. Effects will be most severe when off-road vehicles and heavy equipment are used during moist and wet soils conditions.

With development, the potential for impacts to soil from drilling and produced fluids would increase. Soil contamination from conventional oil and gas development in Montana would result mainly from leaking and improperly reclaimed reserve/brine pits. Produced hydrocarbons and fuel spills would occasionally cause impacts. Spills generally would not be large and the materials would be relatively immobile. Toxic and saline concentrations from the spilled fluids would be capable of sterilizing the soil.

Construction disturbances from conventional oil and gas production would lead to the disturbance of approximately 12,650 acres (9,817.5 acres of BLM-administered surfaces and 2,832.5 acres of state lands) during the next 20 years. Revegetating parts of the well pads during production would reduce the area of disturbance to 4,600 acres. Most of these acres would be remediated after the hydrocarbons have been produced.

When siting impoundments, there are different soil characteristics one should consider before choosing a location. Understanding the existing soil conditions, both at the surface and at depth, will aid operators during impoundment siting and design. Site-specific soils analyses, including soil salinity, soil K- factors, textures, slope, soil classification, Atterberg limits, location and extent of rock strata and permeability, can assist operators to determine the areas most suited for construction of impoundments.

Information should be obtained regarding the types of soils present near impoundments, relative to the clay content, cation-exchange capacity and the percentage of certain soluble mineral assemblages in the soils, each of which can cause changes to the infiltrating water chemistry. Clay mineralogy can affect impoundment design considerations. For instance, within the Powder River RMP, the clays that compose the surface soils are predominantly smectite clays (montmorillonite family), a clay mineral commonly referred to as a "swelling" clay. The swelling nature of smectite is a result of its ability to take water into the clay's internal structure resulting in the expansion or swelling of the clay mineral. This

swelling can result in decreased porosity and permeability of the soils which could cause infiltration rates under impoundments to decrease considerably.

Cation exchange capacity (CEC) is a soil property attributed to the type and quantity of clay minerals and organic matter present in a soil and is the degree to which the soil particles are capable of attracting and holding positively charged (cation) ions on their surface. Soils with lower CEC potential would result in greater geochemical changes to infiltrating water. Gypsum and $CaCO_3$ (calcite) can affect the quality of infiltrating water. Soils analyses, including soil salinity, soil K- factors, textures, slope, soil classification, Atterberg limits, location and extent of rock strata and permeability, can assist operators to determine the areas most suited for construction of an impoundment. The Soils Appendix provides additional information about soils in the Planning Area.

Areas would be reclaimed as prescribed by an approved reclamation plan that includes revegetation to reduce soil erosion. Most soil disturbances and related erosion would begin to be mitigated within 25 days after drilling the well. Exceptions would be sites with severe characteristics (slope and physical and chemical nature of the soils) or sites where saline water spills or site contamination have occurred. These sites may take longer to remediate because special erosion control seeding or remediation measures may be necessary to achieve successful reclamation. These impacts may result in a loss of either soil resources or soil productivity.

Saline water would have a more persistent and detrimental effect on soil productivity. There would be some loss of soil through erosion as a result of surface disturbance, but this would be minimized with an approved surface use plan.

Additional disturbances would occur from coal mining in the CBNG emphasis area, which is estimated at a total of 49,500 acres.

Prime Farmland

If prime farmland exists on federal or state surface where CBNG development is proposed, the same type of reclamation plan would be developed. A difference would be that more topsoil probably would be available for reclamation purposes on a prime farmland site and would be identified in the reclamation plan prior to development.

If the site proposed for development were private surface, then the reclamation plan would be developed in consultation with and according to the wishes of the private landowner. Most likely, the reclamation plan on Federal versus state and private surface would be very similar.

No prime farmlands are known to exist on the federal surface. Privately owned prime farmlands over federal and state leases that are impacted by roads or site development would be reclaimed in accordance with consultation with the private surface owner. This situation would be same for all alternatives.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Impacts on soils may occur from various activities during the exploration, construction, operation and abandonment of CBNG wells developed for the project and may result in a loss of either soil resources or soil productivity. The primary concerns include increased soil erosion, loss of topsoil, mixing of soil horizons, compaction and contamination of soils from various pollutants. These impacts may result in a loss of either soil resources or soil productivity.

Under this alternative, all CBNG water on BLM-administered land would be contained or beneficially used at the well site, while all CBNG water on private lands would be discharged under the existing MPDES permit into the Tongue River (up to 1,600 gpm), impounded, or used for dust control at on-site coal mines.

Exploration

Under Alternative A for BLM-administered surfaces, approximately 400 acres would be disturbed for exploratory wells. On state and private lands, approximately 275 acres would be disturbed during exploration. All produced CBNG water during exploration will be contained; therefore, there would be no impacts to soils caused by high saline/sodium water applications.

Production

There will be no CBNG production on BLM-administered surfaces and therefore no impacts from production. Only state and private lands will have CBNG production. During the construction of the well sites, access roads, utilities and other facilities, 812 acres of soils will be disturbed. Revegetating parts of the well pads during production would reduce the state and private soil disturbances to 500

acres. Production water may be discharged to surface waters in accordance with the existing MPDES Discharge Permits that allow discharge between 3,300 and 4,200 gpm into the Tongue River. This small increase in flow volume is not considered sufficient to cause added erosion to stream banks or streambeds. Produced water may also be used beneficially by industry and landowners, or stored in impoundments onsite. If the quality of the water were acceptable (not too high in SAR or salinity), there would be little or no additional impacts to soils from managed irrigation. If the quality of land-applied water were detrimental, further mitigation measures would need to be implemented to reduce the impacts to soils (ALL 2001a).

Abandonment

After reclaiming the exploratory wells, there will be 500 acres of soil disturbed long-term-all on state and private lands. The area will be reclaimed as prescribed by an approved reclamation plan including revegetation to reduce soil erosion. Soils would be stabilized by vegetative cover and erosion eliminated within 2 to 5 years following the beginning of reclamation. Exceptions may be sites with severe characteristics (slope and physical and chemical nature of the soils) or sites where saline water spills or site contamination have occurred. These sites may take longer to remediate because special erosion control seeding or remediation measures may be necessary to achieve successful reclamation.

There may be some irretrievable loss of soil through erosion as a result of surface disturbance, but this can be minimized with a well-developed and approved surface use plan. Soil beneath unlined surface impoundments would also require extensive reclamation because of accumulation of sodium during infiltration of water. The soils structure could be damaged severely, plant growth would be minimal and accumulation of salt in the soils would likely lead to the soil being treated in-situ or removed and disposed.

Crow Reservation

There would be no impacts to the soils on the Crow Reservation from regional CBNG development.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation soils from regional CBNG development.

Conclusion

During the next 20 years, disturbances from limited CBNG development and exploration, conventional oil and gas development, coal mining and other projects considered under the cumulative effects analysis would result in the disturbance of about 37,500 acres of soil. These disturbances would be reduced to about 36,500 acres during the production phase of CBNG, conventional oil and gas activities and coal mining.

After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities). There would be minimal unavoidable, irreversible and irretrievable impacts to soils. There would be a temporary increase in soil erosion, runoff and sedimentation, mostly during construction activities. If the qualities of land-applied or impounded waters were acceptable, there would be little or no impacts to soils; but if water quality is detrimental, additional mitigation measures would need to be implemented.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Impacts to soils would be reduced under this alternative by requiring transportation corridors; using a single trench for utilities and piping; using multiple completions per well bore and directional drilling; using temporary tank storage and injection of all produced CBNG water; and rehabilitating new roads at the end of the well lifetime. All of these mitigation measures would help to minimize the area of surface disturbances, which would be up to a 35 percent or higher reduction in soil disturbances.

Exploration

Under this alternative, approximately 850 acres of BLM-administered surfaces would be disturbed for exploratory wells. On state and private lands, approximately 1,000 acres would be disturbed during exploration. All produced CBNG water during exploration will be contained; therefore, there would be no impacts to soils caused by high saline/sodium water applications. Losses from exploration would be mostly temporary and would be reclaimed after exploration activities cease.

Production

During the construction of the well sites, access roads, utilities and other facilities, 25,600 acres of

BLM-administered soils and 29,750 acres of state and private soils will be disturbed. Revegetating parts of the well pads during production would reduce the BLM soil disturbances to 15,250 acres and state and private soil disturbances to 17,700 acres. Production water will be injected; therefore, no impacts to soils from CBNG waters will occur.

Abandonment

Reclaiming all of the exploratory wells would provide vegetation cover to 1,850 acres of disturbed soils. Additional reclamation activities at the production wells and utility right-of-ways (ROWs) would further establish vegetation cover to these previously disturbed soils. The disturbed areas would be reclaimed as prescribed by an approved reclamation plan including revegetation to reduce soil erosion. Soils would be recovered and erosion halted within 2 to 5 years, following the beginning of reclamation. Exceptions may be sites with severe characteristics (slope and physical and chemical nature of the soils). There may be some irretrievable loss of soil through erosion as a result of surface disturbance, but this can be minimized with a well-developed and approved surface use plan.

Crow Reservation

There are no tribal sponsored CBNG developments anticipated for the reservation; however, there is the possibility of on-reservation private or private lands being developed in small pockets. These small on-reservation developments are expected to impact the soils in proximity to the wells and associate infrastructure in a similar fashion as describe above in general for Alternative B.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation soils from regional CBNG development. It is not anticipated there would be any tribal sponsored CBNG development on the reservation nor areas of private development.

Conclusion

During the next 20 years, disturbances from CBNG development, conventional oil and gas development, coal mining and other projects considered under the cumulative effects analysis would result in the disturbance of about 117,150 acres of soil. These disturbances would be reduced to about 84,700 acres during the production phase of CBNG, conventional oil and gas activities and coal mining. After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities). There would be minimal unavoidable, irreversible and irretrievable impacts to soils. There would be a temporary increase in soil erosion, runoff and sedimentation, mostly during construction activities.

Development of the Crow and Northern Cheyenne reservations would disturb an initial 24,200 acres or 12,100 acres per reservation. Following the same reclamation measures as commercial CBNG development, the disturbances would be reduced by nearly 10,000 acres. Each reservation would have a residual 7,200 acres of disturbed soils around well pads, access roads, utility corridors and water management facilities.

Alternative C—Emphasize CBNG Development

Under this alternative, impacts on soils would be similar to Alternative B with the following exceptions:

- Untreated CBNG discharge water could be used for managed irrigation
- The discharge of produced water to the ground surface would increase erosion
- There would be a 35 percent increase in impacted soils due to specific management practices for transportation routes

The long-term impacts of using CBNG water or diluted discharge water for agricultural purposes include crop effects, farming practice changes, irrigation management and direct effects to soils. Based on the generally fine texture of the surface soils (clayey) in the emphasis area, much of the soil would likely be susceptible to increasing sodicity when irrigated or land applied with water having a high SAR (generally greater than 3 for some soils and greater than 12 for others). If sodic water is applied to these soils, the probability of soil dispersion (deflocculation) is high, causing infiltration and drainage decreases. The long-term consequence is an anaerobic, waterlogged, saline/sodic soil, which would be difficult to reclaim. Those soils with a coarser texture (sandy to loamy) and good internal drainage will be the least susceptible to increasing sodicity and salinity.

Dispersed soil would also be subject to accelerated erosion leading to gullying, increased sedimentation and harm to riparian vegetation and aquatic habitats. The native species composition in these affected

areas also will change. CBNG water discharge will have the cumulative effect of encouraging the establishment and proliferation of non-native and noxious weed species. As noted in the *Soils Technical Report* (ALL 2001a), there are fewer irrigated than non-irrigated acres along the Tongue and Powder Rivers, which, based on the RFD, is where a majority of the potential CBNG activity would reside. However, if adequate water and suitable agricultural soils were available in areas adjacent to production, more irrigated land would be available for production and use.

The use of high salinity/sodium CBNG water may have long-term effects on crops, limiting crops to those that are more salt tolerant. Additional irrigation water would be required for leaching to ensure salts are moved out of the root zone. Increasing the frequency of irrigation may also need to be implemented to maintain soil water content and to decrease the effects of applying saline water (lower water-holding capacity and higher salinity levels). These increases in irrigation water amounts would lead to producers having to file for additional water rights or finding other sources of lower salinity water for leaching, as well as a potential for more saline seeps in areas irrigated with CBNG water. The *Soils Technical Report* (ALL 2001a) discusses the impacts of discharging CBNG waters to soils in more detail.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except water generated by testing CBNG wells could be discharged to surface waters and the land surface-with impacts as discussed above.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except untreated water generated during production could be discharged to surface water with appropriate permits and to the land surface at the well pad. Impacts of managed irrigation of CBNG waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would be rehabilitated and closed. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn rivers. Impacts associated with on-reservation private lands would be similar to those described in general for Alternative B. In addition, impacts associated with direct discharge practices as described for Alternative C would be expected for these wells.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be expected to soils being irrigated with waters from the Tongue River and Rosebud Creek. Since these waterbodies would experience increases in their SAR and EC values, it is conceivable that tribal irrigators would also experience the types of soil impacts described in general for Alternative C. Soils impacts from tribal sponsored development on the reservation are not anticipated for this alternative.

Conclusion

Cumulative impacts would be similar to Alternative B, except that the surface disturbances would increase by up to 35 percent and surface discharge and irrigation of produced water would increase detrimental impacts to soils. Saline water has a more persistent and detrimental effect on plants' ability to extract water. Cumulative disturbances from all regional projects would result in the disruption of about 138,360 short-term acres of soil. These disturbances would be reduced to about 105,900 acres during the production phase of CBNG, conventional oil and gas activities and coal mining.

One advantageous side effect would be that more water would be available for irrigation if acceptable agricultural land is available, but if acceptable qualities of water are not used, there could be an increased detrimental impact on additional soils.

Soil disturbance levels on the Crow and Northern Cheyenne Reservations would be similar to those discussed in the Conclusions section of Alternative B, (12,100 – 7,200 acres); however, they are expected to be somewhat increased due to the surface discharge of production water.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Under this alternative, impacts on soils would be similar to Alternative B except that produced water

would be treated prior to discharge onto the surface or for irrigation and not injected, which would reduce the detrimental impacts caused by application of high-SAR water to soils.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except that water generated by testing CBNG wells would be treated prior to discharge to surface waters and the land surface (instead of injection), which lessens the impacts caused by application of high-SAR water to soils.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except water generated during production would be treated prior to discharge to the land surface and to surface water-with appropriate permits. Impacts of the managed irrigation of CBNG waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would remain open or closed at surface owner's discretion. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

The only soils impacted on the Crow Reservation would be from on-reservation private developments similar to those previously described in Alternative B.

Northern Cheyenne Reservation

There would be no impacts to soils on the Northern Cheyenne Reservation from regional CBNG development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted, since production water will be treated prior to discharge.

Conclusion

Cumulative impacts would be similar to Alternative B with the exception that produced water would be treated prior to discharge onto the surface and not injected, which would reduce the detrimental impacts caused by application of high-SAR water to soils.

Soils disturbance levels on the Crow and Northern Cheyenne reservations would be similar to those discussed in the Conclusions section of Alternative B, (12,100 – 7,200 acres).

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Under this alternative, impacts on soils would be similar to Alternative B except produced water would be managed per a site-specific Water Management Plan with first priority being beneficial use of produced water; impoundments designed to minimize or mitigate impacts to soil, water and vegetation; an option for injection of CBNG water; and no degradation of a watershed. All of these factors would reduce the detrimental impacts caused by application of high-SAR water to soils. There would be a 35 percent increase in impacted soils over alternatives B and D due to specific management practices for transportation routes-this percent will vary depending on site-specific Project Plans for ROWs agreed upon with the surface owners.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B, except that water generated by testing CBNG wells would not be allowed to degrade the watershed, which lessens the impacts caused by application of high-SAR water to soils.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except water generated during production would be beneficially used, stored in impoundments, or discharged without impacts to the watershed. Impacts of the managed irrigation of CBNG waters are discussed above.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B. Roads would remain open or closed at surface owner's discretion. The use of unlined impoundments would have impacts similar to those mentioned in Alternative A.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn rivers. Impacts associated with on-reservation private lands would be similar to those described in general for Alternative B.

Northern Cheyenne Reservation

There would be no impacts to soils on the Northern Cheyenne Reservation from regional CBNG development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted, since only slight alterations in surface water quality are anticipated.

Conclusion

Cumulative impacts would be similar to Alternative B with the exception that produced water would be managed per a site-specific Water Management Plan that would be geared toward minimizing impacts to soil, water and vegetation and surface owners would have more input in the Project Plan for the transportation corridors. Cumulative disturbances from all regional projects would result in the disruption of about 135,600 short-term acres of soil. These disturbances would be reduced to about 95,800 acres during the production phase of CBNG, conventional oil and gas activities and coal mining. Soils disturbance levels on the Crow and Northern Cheyenne reservations would be similar to those discussed in the Conclusions section of Alternative B, (12,100 – 7,200 acres). It is anticipated the tribes would manage or require their produced water to be managed in a similar manner to what will be required of off-reservation commercial CBNG developers. With this assumption no additional impacts to reservation soils are anticipated from on-reservation development.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative, impacts on soils would be similar to Alternative B except the impacts to soils would be delayed due to the phased approach used by the BLM in the approval of APDs based on the number of federal APDs approved each year and within each 4th Order Watershed. These combined limits would serve to level the impacts over a 23 year development timeframe thus eliminating periods of high impact due to peak development. The leveling of development resulting from a phased approach would reduce the overall detrimental impacts caused by the application of high SAR water to soils.

Soils on the Crow and Northern Cheyenne reservations would not be impacted by CBNG development off of the reservations unless the tribes approved certain activities, such as irrigation or impoundment construction, to occur on the reservations. Impacts to soils from such activities would be the same as described in Alternative C.

Exploration

Under this alternative, impacts on soils would be similar to Alternative B.

Production

Under this alternative, impacts on soils would be similar to Alternative B, except the impacts would be spread over a longer period of time and the restrictions on volumes of untreated discharge waters in 4th Order watersheds may slightly reduce impacts to soils in the riparian zone.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative B, except for the impact being spread out over a longer period of time.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn rivers. Impacts associated with on-reservation private lands would be similar to those described in general for Alternative B.

Northern Cheyenne Reservation

Similar to Alternative B, there would be no impacts to soils on the Northern Cheyenne Reservation from regional CBNG development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted since limits would be in place on the volume of untreated CBNG water that could be discharged from the development of federal minerals.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative B with the exception that impacts would be delayed due to the implementation of cumulative and watershed specific numerical limits on the number of federal CBNG APDs approved per year. Cumulative disturbances from all regional projects would be similar to Alternative B which would result in the disruption of about 117,050 short-term acres of soil. These disturbances would be reduced to about 84,600 acres during the production phase of CBNG, conventional oil and gas activities and coal mining. Soils disturbance levels on the Crow and Northern Cheyenne reservations would be similar to those discussed in the Conclusions section of Alternative B (12,100 – 7,200 acres). It is anticipated the tribes would manage or require their produced water to be managed in a similar manner to

what will be required of off-reservation commercial CBNG developers. With this assumption no additional impacts to reservation soils are anticipated from on-reservation development.

As with most other impacts described under this alternative, if crucial sage-grouse habitat areas are not developed, the overall impacts to soils would be reduced by a factor of approximately 12.8 percent within the development area. While some level of development is anticipated within these areas, it is likely to be less dense than the 80-acre spacing accounted for in other alternatives.

Alternative G—Phased Development Multiple Screens (Low Range)

Under this alternative, impacts on soils would be similar to Alternative F except they would be reduced by approximately 65 percent based on the fewer number of APDs predicted to be issued. Under Alternative G, the annual cumulative limit placed on federal APDs approved by BLM would be set at five percent (323 APDs) of the low-range number of state, private and federal CBNG APDs (6,470) predicted to be approved in the RMP areas (as identified in the Reasonably Foreseeable Development scenario in the Statewide document). A limit would also be established on the number of federal APDs approved each year within each 4th Order Watershed. This limit would be set at the total number of wells predicted for each watershed times the predicted rate of development in the Statewide document. These combined limits would serve to level the potential impacts to soils over a 23 year development period.

Soils on the Crow and Northern Cheyenne reservations would not be impacted by CBNG development off of the reservations unless the tribes approved certain activities, such as irrigation or impoundment construction, to occur on the reservations. Impacts to soils from such activities would be the same as described in Alternative C.

Exploration

Under this alternative, impacts on soils would be similar to Alternative F.

Production

Under this alternative, impacts on soils would be similar to Alternative F except that they would be reduced by approximately 65 percent due to the lower level of predicted development.

Abandonment

Under this alternative, impacts on soils would be similar to Alternative F except that they would be reduced by approximately 65 percent due to the lower level of predicted development.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn rivers. Impacts associated with on-reservation private lands would be similar to those described in Alternative F.

Northern Cheyenne Reservation

Similar to Alternative F, there would be no impacts to soils on the Northern Cheyenne Reservation from regional CBNG development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted since limits would be in place on the volume of untreated CBNG water that could be discharged from the development of federal minerals.

Conclusion

Under this alternative, cumulative impacts would be similar to Alternative F with the exception that impacts would be reduced by approximately 65 percent due to the lower level of predicted development.

As in Alternative F, it is anticipated the tribes would manage or require their produced water to be managed in a similar manner to what will be required of off-reservation commercial CBNG developers. With this assumption no additional impacts to reservation soils are anticipated from on-reservation development.

Alternative H—Preferred Alternative - Multiple Screens

Under this alternative, impacts on soils would be similar to Alternative F; however, the use of the multiple screens would serve to level the impacts over the development period thus eliminating periods of high impact due to peak development. The leveling of development would reduce the overall detrimental impacts caused by the application of high SAR water to soils.

Impacts to soils would be further reduced under this alternative by requiring long-term planning for transportation corridors and utility ROWs; using multiple completions per well bore and directional

drilling; and rehabilitating new roads at the end of the well lifetime. All of these would help to minimize the area of surface disturbances, which would result in an approximate 25 percent reduction in soil disturbances.

Under this alternative produced water would be managed per a site-specific Water Management Plan with first priority being beneficial use of produced water; impoundments designed to minimize or mitigate impacts to soil, water and vegetation; an option for injection of CBNG water; and no degradation of a watershed. All of these factors would reduce the detrimental impacts caused by application of high-SAR water to soils.

Soils on the Crow and Northern Cheyenne reservations would not be impacted by CBNG development off of the reservations unless the tribes approved certain activities, such as irrigation or impoundment construction, to occur on the reservations. Impacts to soils from such activities would be the same as described in Alternative C.

Exploration

Under this alternative, approximately 850 acres of BLM-administered surface would be disturbed for exploratory wells. On state and private lands, approximately 1,000 acres would be disturbed during exploration. All produced CBNG water during exploration will be contained; therefore, there would be no impacts to soils caused by high saline/sodium water applications. Losses from exploration would be mostly temporary and would be reclaimed after exploration activities cease.

Production

Under this alternative, impacts on soils would be spread over a slightly longer period of time, development would occur at a more level rate and the restrictions on volumes of untreated discharge waters in 4th Order watersheds would be imposed, resulting in a marked reduction of impacts to soils. Furthermore, consolidated transportation and utility planning for the construction of the well sites, access roads, powerlines, pipelines and other facilities, would reduce the amount of soils disturbed. Revegetating parts of the well pads during production would further reduce the BLM soil disturbances. Water generated during production would be beneficially used, stored in impoundments, or discharged without impacts to the watershed.

Abandonment

Under this alternative, impacts on soils would be spread out over a longer period of time thus delaying some reclamation activities. Reclaiming all of the exploratory wells would provide initial vegetative cover to disturbed soils. Additional reclamation activities at the production wells and utility ROWs would further establish vegetative cover to these previously disturbed soils. The disturbed areas would be reclaimed as prescribed by an approved reclamation plan including revegetation to reduce soil erosion. Soils would be recovered and erosion minimized within two to five years, following the beginning of reclamation. Exceptions may be sites with severe characteristics (slope and physical and chemical nature of the soils) or sites where saline water spills or site contamination have occurred. These sites may take longer to remediate because special erosion control seeding or remediation measures may be necessary to achieve successful reclamation. There may be some irretrievable loss of soil through erosion as a result of surface disturbance, but this can be minimized with a well-developed and approved surface use plan.

Soil beneath unlined surface impoundments would require extensive reclamation because of the accumulation of sodium during infiltration of water. The soils structure could be damaged severely, plant growth would be minimal and accumulation of salt in the soils would likely lead to the soil being treated in-situ or removed and disposed.

Crow Reservation

The Crow Reservation would not experience impacts to soils being irrigated with waters from the Bighorn or Little Bighorn rivers. Impacts associated with on-reservation private lands are expected to impact the soils in proximity to the wells and associated infrastructure in a similar fashion as described above in general.

Northern Cheyenne Reservation

Similar to Alternative F, there would be no impacts to soils on the Northern Cheyenne Reservation from regional CBNG development. Lands irrigated with waters from either Rosebud Creek or the Tongue River are not expected to be impacted since limits would be in place on the volume of untreated CBNG water that could be discharged from the development of federal minerals. It does not appear there would be any tribally-sponsored CBNG development on the reservation nor areas of private development in the near future. However, if development were to be

initiated on the reservation soil impacts would be in proximity to the wells and associated infrastructure in a similar fashion as described under this alternative in general.

Conclusion

Cumulative disturbances from all regional projects would be similar to Alternative F which would result in the short-term disruption of about 117,050 acres of soil. These disturbances would be reduced to about 84,600 acres during the production phase of CBNG, conventional oil and gas activities and coal mining. After production ceases and lands used for production and mining are abandoned, most land can be returned to production (excluding permanent roads and facilities). There would be minimal unavoidable, irreversible and irretrievable impacts to soils. There would be a temporary increase in soil erosion, runoff and sedimentation, mostly during construction activities.

Produced water would be managed per a site-specific Water Management Plan geared toward minimizing impacts to soil, water and vegetation and surface owners would have more input in the Project Plan for the transportation corridors.

Development of CBNG on the Crow and Northern Cheyenne reservations would disturb an initial 24,200 acres or 12,100 acres per reservation. Following the same reclamation measures as commercial CBNG development, the disturbances would be reduced by nearly 10,000 acres. Each reservation would have a residual 7,200 acres of disturbed soils around well pads, access roads, utility corridors and water management facilities. It is anticipated the tribes would manage or require their produced water to be managed in a similar manner to what will be required of off-reservation commercial CBNG developers. With this assumption no additional impacts to reservation soils are anticipated from on-reservation development.

Solid and Hazardous Waste

Solid and Hazardous Wastes *Solid and hazardous wastes are under the jurisdiction of the MDEQ for RCRA wastes, MBOGC for RCRA exempt wastes and the EPA for wastes generated on tribal lands*
Alternative A **No Action (Existing CBNG Management)**
• Typical solid waste refuse can be disposed of in local landfills. • Drilling mud and cuttings can be disposed of onsite with the landowner's permission. • Minor impacts would also occur from the use of pesticides and herbicides during access and construction activities
Alternatives B, C, D, E, F and G
• Impacts for Alternative B, C, D, E, F and G would include increased quantities of waste requiring onsite disposal or transport to commercial landfills. • Oil and gas developers are responsible for any damages to property, real or personal, resulting from the lack of ordinary care during operations. Operators are required to maintain SPCC plans and immediately remove any spilled or unused non-exempt wastes from the sites. • No long term impacts to private, state or federal lands would occur from waste products associated with CBNG development.
Alternative H **Preferred Alternative - Multiple Screens**
• Typical solid waste refuse can be disposed of in local landfills. • Drilling mud and cuttings can be disposed of onsite with the landowner's permission. • Minor impacts would also occur from the use of pesticides and herbicides during access and construction activities • Impacts would include increased quantities of waste requiring onsite disposal or transport to commercial landfills. • Oil and gas developers are responsible for any damages to property, real or personal, resulting from the lack of ordinary care during operations. Operators are required to maintain Spill Prevention Control and Countermeasures (SPCC) plans and immediately remove any spilled or unused non-exempt wastes from the sites. • No long term impacts to private, state or federal lands would occur from waste products associated with CBNG development.

Assumptions

All wastes generated by oil and gas operations including CBNG that are Resource Conservation and Recovery Act of 1976 (RCRA)-classified wastes, such as paint wastes or RCRA-exempt wastes such as drilling wastes, would be disposed of in accordance with regulations. Any release of a hazardous material would be reported in a timely manner to the relevant agency or to the BLM via a Report of Undesirable Event (NTL-3A). Any release of a CERCLA substance would be reported in accordance with regulations.

Impacts From Management Common to All Alternatives

Typical solid waste refuse would be generated by oil and gas drilling operations and can be disposed of in local landfills. The largest volume of waste generated from drilling activities would be from the drilling mud and cuttings generated. These drilling wastes would be exempt from RCRA and are considered non-hazardous. Drilling mud containing less than 15,000 mg/l TDS can be disposed of on-site with the landowner's permission. The amount of waste generated should not exasperate the landfills in the area. Other impacts would result from spills of waste during maintenance activities, including waste oil from generators, paint waste from construction activities and other solid wastes from construction activities. Impacts would also occur from the use of pesticides and herbicides during access and construction activities.

The TRR plans to principally transport coal; any potentially hazardous chemicals and materials would only be those associated with its operation of the railroad as a coal transporter. Petrochemicals, such as diesel fuel and lubricants, would be the primary hazardous materials involved in operating such a train. Given the route of the TRR and the sparse population and no industry, there is little expectation hazardous materials would be transported. In the event the TRR should decide to transport these types of materials, it would undertake the plans and procedures required by state and federal laws to insure their safe handling and storage including training of employees. The TRR would operate in full compliance with Hazardous Materials Transportation Act (49 U.S.C. 1080 et seq.), governing regulations and rail industry guidelines for the transportation of hazardous materials. It is not anticipated these materials would cause any impact to regional landfills or exposure to the surrounding environment.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Impacts from Alternative A would be similar to the impacts described in the previous *Impacts From Management Common to All Alternatives* section. The solid and hazardous waste generated during CBNG exploration, production and abandonment would be similar to conventional oil and gas. The drilling muds would be of lesser quantity because of the shallow drilling depths for CBNG wells compared to conventional oil and gas.

Crow Reservation

There are no CBNG developments anticipated on tribal Lands under this alternative and therefore no impacts are expected. Furthermore, there would be no impacts on the reservation from the use of solid and hazardous materials on off-reservation CBNG operations.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation from solid or hazardous material use on off-reservation CBNG developments.

Conclusion

The cumulative impacts of this alternative would include the solid and hazardous waste generated from conventional oil and gas, surface mining activities and CBNG development. These other activities would result in increased production of both solid and hazardous waste that occur as part of general operation activities. Mitigation would include the disposal of all wastes in accordance with applicable federal, state and local regulations.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

The impacts from this alternative would be similar to the impacts under Alternative A. However, CBNG development would result in larger quantities of solid and hazardous waste production.

Crow Reservation

There are no tribal sponsored CBNG developments anticipated on the reservation under this alternative; however, private lands on the reservation could have private CBNG developments. These small developments are expected to generate solid and hazardous wastes in the same proportions as their off-reservation counterparts. These wastes will need to be disposed of in accordance with applicable tribal and EPA regulations.

There would be no impacts on the reservation from the use of solid and hazardous materials on off-reservation CBNG operations.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation from solid or hazardous material use on off-reservation CBNG developments.

Conclusion

The cumulative impacts from this alternative would be similar to Alternative A. However, the increased scale of CBNG development, including the potential development of CBNG on the Crow and Northern Cheyenne reservations and USFS lands, would increase the volume of solid and hazardous waste generated. The increased volume of solid and hazardous wastes would result in local landfills reaching capacity sooner, which would generate the need for the construction of new landfills that would further disturb lands. The additional trucks used for hauling waste would increase traffic and air emissions.

Wastes generated on the reservations from tribal development would need to be disposed of following EPA regulations and tribal laws, if any. This may necessitate the construction of a non-hazardous landfill for the acceptance of solid wastes from the RFFA estimate of 4,000 wells per reservation.

Alternative C—Emphasize CBNG Development

The impacts under Alternative C would be the same as for Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

The impacts under Alternative D would be the same as for Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

The impacts under Alternative E would be the same as for Alternative B.

Alternative F—Phased Development Multiple Screens (High Range)

The impacts under Alternative F would be similar to those described for Alternative B, however local landfills would receive solid and hazardous wastes at a reduced pace resulting in the capacity of the landfills to extend further. Construction of new landfills would also be delayed. Traffic and air emissions from trucks hauling CBNG generated wastes would be reduced.

Alternative G—Phased Development Multiple Screens (Low Range)

The impacts under Alternative G would be similar to those described for Alternative F but reduced by approximately 65 percent based on the fewer number of APDs predicted to be issued. Under Alternative G, the annual cumulative limit placed on federal APDs approved by BLM would be set at five percent (323 APDs) of the low-range number of state, private and federal CBNG APDs (6,470) predicted to be approved in the RMP areas (as identified in the Reasonably Foreseeable Development scenario in the Statewide document).

Alternative H—Preferred Alternative - Multiple Screens

Typical solid waste refuse would be generated by oil and gas drilling operations and can be disposed of in local landfills. The largest volume of waste generated from drilling activities would be from the drilling mud and cuttings generated. These drilling wastes would be exempt from RCRA and are considered non-hazardous. Drilling mud containing less than 15,000 mg/l TDS can be disposed of on-site with the landowner's permission. The amount of waste generated should not overwhelm the landfills in the area. Other impacts would result from spills of waste during maintenance activities, including waste oil from generators, paint waste from construction activities and other solid wastes from construction activities. Impacts would also occur from the use of pesticides and herbicides during access and construction activities.

The solid and hazardous waste generated during CBNG exploration, production and abandonment would be similar to conventional oil and gas. The drilling muds would be of lesser quantity because of the shallow drilling depths for CBNG wells compared to conventional oil and gas. However, CBNG development would result in larger quantities of solid and hazardous waste production due to the number of wells predicted.

Crow Reservation

The tribal sponsored CBNG developments anticipated on the reservation under this alternative coupled with the private lands on the reservation would generate solid and hazardous wastes in the same proportions as their off-reservation counterparts. These wastes will need to be disposed of in accordance with applicable tribal and EPA regulations. There would be no impacts on the reservation from the use of solid and hazardous materials on off-reservation CBNG operations.

Northern Cheyenne Reservation

There would be no impacts on the Northern Cheyenne Reservation from solid or hazardous material use on off-reservation CBNG developments. It is not anticipated the Northern Cheyenne would develop any CBNG wells on the reservation for the foreseeable future.

Conclusion

The cumulative impacts from this alternative would result in drilling wastes and construction debris being generated as previously described. However, the increased scale of CBNG development, including the potential development of CBNG on the Crow and Northern Cheyenne reservations and USFS lands, would increase the volume of solid and hazardous waste generated. The increased volume of solid and hazardous wastes would result in local landfills reaching capacity sooner than originally planned. Eventually new landfills would need to be constructed to manage the county and tribal wastes as typical domestic and commercial waste generation will continue. These new landfills would disturb lands but are anticipated, in long-term plans.

The Tongue River Railroad plans to principally transport coal; any potentially hazardous chemicals and materials would only be those associated with operation of the railroad as a coal transporter. Petrochemicals, such as diesel fuel and lubricants, would be the primary materials involved in operating such a train. It is not anticipated these materials

would cause any impact to regional landfills or exposure to the surrounding environment.

Wastes generated on the reservations from tribal development would need to be disposed of following EPA regulations and tribal laws. This may necessitate the construction of a non-hazardous landfill for the acceptance of solid wastes from the RFFA estimate of 4,000 wells per reservation.

Vegetation

Vegetation
Acreages by land classification overlaying coal beds: *- Grasslands, 3.55 million (2.56 million in RMP areas)* *- Shrublands 1.8 million, (1.66 million in RMP areas)* *- Forests, 1.36 million (1.29 million in RMP areas)* *- Riparian Areas, 378,000 (268,000 in RMP areas)* *- Barren Lands, 372,000 (297,000 in RMP areas)* *87,400 acres overlaying coal beds currently contain non-native plants and noxious weeds (37,000 acres in the Planning Area).*
Alternative A **No Action (Existing CBNG Management)**
• 1,142 acres of native habitat would be impacted under this Alternative, more than half (580 acres) in grasslands. • No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• 55,400 acres of native habitat could be impacted under this Alternative, with 21,450 acres in grasslands. • No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.
Alternative C **Emphasize CBNG Development**
• 70,000 acres of native habitat could be impacted under this Alternative, with 27,300 acres in grasslands. • If SAR values exceed 10 in water, riparian vegetation would be impacted, affecting as many as 3,535 acres of riparian habitat. • No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• 55,400 acres of native habitat could be impacted under this Alternative, with 21,450 acres in grasslands. • Hydrology changes may affect as much as 2,776 acres of riparian habitat due to increased stream flow. • No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• Impacts would be similar to those for Alternative D, however no riparian habitat would be affected. • No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.
Alternative F **Phased Development Multiple Screens (High Range)**
• Impacts would be similar to those for Alternative B. • Resource impacts from proposed development projects would be evaluated on a watershed-level basis. • Annual and watershed-based limits on federal CBNG development would result in a different spatial and temporal distribution of impacts than the other development alternatives. • Watershed-based analysis would limit the amount of disturbed habitat on BLM-administered surface or on private surface overlying federal minerals within each 4th Order watershed, based on the potential to affect species of special concern from habitat fragmentation. • No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to Alternative F but the land disturbance area would be 65 percent less. • No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts would be similar to those for Alternative B. • Resource impacts from proposed development projects would be evaluated on a watershed-level basis. • Use of resource screens and watershed-based limits on federal CBNG development would result in a spatial and temporal distribution of impacts similar to Alternative F. • Watershed-based analysis would limit the amount of disturbed habitat on BLM-administered surface or on private surface overlying federal minerals within each 4th Order watershed, based on the potential to affect species of special concern from habitat fragmentation. • No federal threatened or endangered plant species are known to occur within the FSEIS Planning Area.

Assumptions

The Miles City BLM *Seeding Policy*, dated October 27, 1999 (BLM 1999c), lists guidelines for seeding practices by typical Montana soil types; it is assumed this policy will be implemented where appropriate. Recommended species are identified for quick coverage of disturbed soils, to discourage invasion of noxious weeds and to attenuate soil erosion. Reclamation work will be considered complete when the disturbed area is stabilized, soil erosion is controlled and at least 60 percent of the disturbed surface is covered with the prescribed vegetation.

Under all alternatives, most riparian areas and certain wildlife habitats (see the *Wildlife* section) are protected from direct impact under current stipulations on BLM-

administered surface that restrict surface occupancy but not road crossings (BLM 1994).

Although, no federal threatened or endangered plant species are known to occur in the Planning Area, surveys to confirm the absence of federally listed species would occur on BLM-administered surface or minerals. The APD requires that BLM determine if the proposed development plan would affect any species listed as threatened or endangered.

Formal consultation with the FWS would occur for site-specific federal CBNG projects developed under this EIS if a federally listed threatened and endangered (T&E) species or candidate or proposed species may be affected. Section 7(a) of the Endangered Species Act (ESA) requires that federal actions "are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or undesirable modification of its habitat." BLM policy for proposed and candidate species is to avoid actions that would jeopardize a species and require formal listing under the ESA.

Special management attention is given by state and federal agencies to state and BLM Species of Concern. Agencies approve actions to avoid areas that would jeopardize a species and thereby require federal protection in the future.

The MBOGC environmental review includes an assessment of potential impacts to vegetation during construction and drilling operations. MBOGC policies require the operators to minimize the size of drilling pads and require complete restoration of the area once operations are complete (Administrative Rules of Montana [ARM] 36.22). Mitigation plans are included with the environmental review to notify operators of requirements prior to construction.

For federal actions, FWS is required to provide consultation or provide comments to federal agencies if the potential for taking occurs. They do not have this same requirement for state agencies. Even if a state agency requests a consultation, the FWS does not have the authority to provide it. If a state or private CBNG project triggers a federally related action, the FWS would need to be consulted for federally protected species, by the federal agency.

The FWS would be consulted under Section 10 of the ESA if a federally related action is triggered.

On BLM-administered surfaces, where specific stipulations do not exist or do not currently apply, there is a presumption that impacts on T&E plant species would be avoided through development and observation of specific conservation measures developed through consultation with FWS intended to avoid impacts on T&E species as required under the ESA.

Impacts on T&E plants on non-federal lands are less likely to be avoided through conservation measures because they are not protected.

Species of concern on all lands would likely receive a relatively high degree of protection at a regional scale because federal and state agencies are committed to avoiding measures that would require listing protection under ESA. However, this would likely not protect all individuals or perhaps some populations within the region.

BLM field clearances and other required pre-exploration activities developed through this EIS process and which are intended to identify site-specific occurrence of T&E species, would be conducted as specified, leading to knowledge of specific resources and implementation of appropriate avoidance actions and conservation measures discussed above.

Federal and state agency monitoring of exploration, development and production activities are assumed to be adequate to ensure all lease conditions and ESA requirements are followed.

Preventing the spread of noxious weeds is easier, more successful and less costly and time-consuming than reclamation or mitigation. Stipulations for current exploration authorizations within the Billings and Powder River RMP areas cover weed management and riparian/wetland management (BLM 1992). Under these stipulations, all categories of noxious weeds must be managed.

Stipulations and options for containment of noxious weeds on state lands are listed in the Minerals Appendix, Table MIN-5.

The BLM has co-developed an action plan for weed containment and eradication practices that will be implemented for all alternatives (BLM 1996). Pertinent sections of Appendix 3 from that document are reproduced in Table 4-63. The action plan applies to the State of Montana's list of weed species of concern (see Table VEG-7, Vegetation Appendix). This list includes species that are considered to be highly invasive and disruptive to natural systems. It is assumed that these weed-prevention activities will be required for CBNG exploratory and production sites, roadways, pipelines, utility corridors and other disturbed sites on BLM-administered surface except as specifically noted for some of the alternatives.

TABLE 4-63

EXAMPLE: PARTIAL BLM DISTRICT-WIDE WEED PREVENTION SCHEDULE

Prevention Activity	When	Who Is Responsible
Clean off-road equipment with powerwash or high-pressure to remove all mud, dirt and plant parts before moving into relatively weed-free areas.	All Year	Equipment Operators; Fire Crew
Re-establish vegetation on all disturbed soil from construction, reconstruction and maintenance activities.	Spring/Fall	Project Proponent
Inspect gravel pits and fill sources to identify weed-free sources. Gravel and fill to be used in relatively weed-free areas must come from weed-free sources.	Spring/Summer	Surface Protection Specialist; Equipment Operator
Retain bonds (for mineral activity) for weed control until the site is returned to desired vegetative conditions.	All Year	Mineral Specialist
Include weed-risk considerations for environmental analysis for habitat improvement projects.	All Year	Wildlife Biologist
Provide weed identification training for field-going employees and managers.	Winter/Summer	Weed Coordinator
Distribute public information/brochures.	Spring/Summer	Public Affairs Officer
Include weed risk factors and weed prevention considerations in Resource Advisor (Environmental Specialist) duties on all Incident Overhead Teams and Fire Rehabilitation Teams.	Summer	Resource Advisor

Note: Revised from BLM 1996.

Wetlands are legally protected by Section 404 of the Clean Water Act. Therefore, all such wetlands must be surveyed and delineated before any drilling can take place. If wetlands will be impacted by proposed drilling or road alignments, they must be avoided or mitigation measures must be developed to compensate for impact. This compensation may include the development of replacement wetlands. In some instances, Nationwide 404 Permits may apply to CBNG projects. Applicable permits include Utility Line Activities and Linear Transportation Crossings. The producers must meet all terms and conditions of the Nationwide 404 Permit for it to apply.

On private lands, it is assumed that the private landowner will negotiate with the producer before exploration and development and come to an agreement as to what measures the producer will instigate for weed control, site restoration and as to what criteria constitutes successful site restoration and proper weed control.

Impacts From Management Common to All Alternatives

Construction of facilities and roads would cause the primary effects on vegetation. For a developed well site, about 40 percent of the original drill site would remain disturbed for the life of the well (20 years). However, unsuccessful exploratory sites would be reclaimed. Reclamation generally includes spreading topsoil and reseeding according to the landowner's request (private land) or the BLM *Seeding Policy* (BLM 1999c). The BLM *Seeding Policy* and site restoration stipulations do not extend beyond the borders of their lands. Therefore, it is essential that private landholders negotiate with the producer prior to exploration and development on private lands and come to an agreement as to what measures the producer must instigate for weed control and site restoration. This includes what criteria will be used to assess adequate site restoration and proper weed control. Pre-development agreements are the responsibility of the landowner.

Small areas of vegetation would be lost to roads and drill sites for each well. Dust and vehicle emissions could reduce growth of vegetation adjacent to roads and drill sites. If disturbed areas are prepared and seeded properly, reclamation may further reduce the effects of dust. The effects of drilling on vegetation would be of particular concern under the following circumstances:

- When drill sites or roads are proposed within or cross riparian areas, wooded drainages, or wetlands
- Where drill sites or roads would cause sedimentation or channel down-cutting in riparian areas
- When drill sites or roads would be in areas that contain populations of special status plants
- Where operations could spread or encourage the growth of weeds
- In case of reserve pit leakage
- In the event of blowouts or wildfire

Drilling sometimes may occur in or near areas that support riparian vegetation or special status plants. If located in or at the head of drainages, drill sites and access roads can add sediment to streams and wetlands. Channel degradation can also occur. Heavy sediment loads or severe degradation would affect riparian vegetation. Roads and facilities are supposed to avoid sensitive areas "to the extent practicable." Therefore many, but not all, sensitive areas such as riparian areas and wetlands would be avoided.

Soil disturbance associated with drilling can cause weeds to spread. Of even greater concern is the long-distance transport of certain weed species by drilling equipment and vehicles. Weed spread is reduced if disturbed areas are re-vegetated during the season of disturbance or the next growing season as recommended (Table 4-63). All well drilling operations are covered by the County Noxious Weed Control Act, which holds landowners responsible for weed control. The contribution of oil and gas drilling to weed spread is comparable to other types of construction.

Because of the legal restrictions placed on the harm or take of federally listed species, direct impacts to these listed species would not occur on federal land. Indirect impacts to federally listed species such as habitat destruction will be addressed on a species-by-species basis. Federally listed plant species on non-federal land ownership may be impacted through conventional oil and gas activities because threatened and endangered plants on private lands are generally not surveyed and their presence may not be known.

Mitigation

Site clearance surveys would be conducted prior to disturbance. Where necessary, operator plans would be adjusted as appropriate to avoid impacts to federally listed species.

Review of Montana Natural Heritage Program data on a case-by-case basis for TLMD Montana Oil and Gas lease sale may indicate areas of plant locations on state lands. A vegetation survey stipulation is used on the lease. For site-specific proposals, the TLMD field staff may consult with DNRC biologists and Montana-NHP botanists as needed. The TLMD stipulation (see Table MIN-5), reads as follows: "Plant species of concern have been identified on or near this tract. A vegetation survey in areas of proposed activity will be required prior to disturbance. Identified rare plant species will be avoided, unless authorized by the TLMD."

Conclusions

There would be no impact on federal land to federally listed species. There may be impacts to federally listed plants on non-federal land and to other species of concern.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Previous authorizations have allowed selected CBNG exploration in the Powder River and Billings RMP areas as well as selected well development and exploration on state lands.

Disturbance to vegetation is of concern because wildlife habitat and livestock production capabilities may be diminished or lost over the long-term through direct loss of vegetation (including direct loss of both plant communities and specific plant species). Indirect impacts, such as noxious weed invasion erosion could result in loss of desirable vegetation. Under the No Action Alternative, only riparian habitat types and certain wildlife habitats (see *Wildlife* section) are protected under current stipulations (BLM 1995).

Direct impacts on vegetation would occur during land-disturbing activities associated with installation of exploratory or development CBNG wells that remove vegetation to construct a facility (e.g., roads, drilling pads, mud pits). All direct impacts from exploratory wells are for the life of the well, then rehabilitated. Both temporary and permanent impacts would occur with installation of development wells.

DNRC, TLMD uses buffer stipulations and use of the no-surface-occupancy of navigable riverbeds and related acreage stipulation on its oil and gas leases on a case-by-case basis for protection of riparian habitat. Table 4-64 summarizes the acreage that could be potentially impacted in the two RMP areas and the three counties under state-permitting jurisdiction.

Vegetation types to be potentially impacted were determined based on the extent of each vegetation type overlying coal beds. Impacts to specific vegetation types were assigned in proportion to their total acreage within an ownership (see Table 4-64). For example, there are 1,537,000 acres of grassland in the Powder River RMP area or 40 percent of the total area. Assuming that 200 acres would be permanently disturbed in the Powder River RMP area, 80 acres (40 percent) of permanent, direct impacts would be expected to occur in grassland. If natural communities from Table 4-65 are considered, grasslands would be expected to experience the largest permanent loss (580 acres), based on occurrence. Shrubland would be the next most permanently impacted habitat (174 acres), followed by forest land (114 acres), barren land (46 acres) and riparian habitat (56 acres). Of the 56 permanently impacted riparian acres, 20 are on BLM-administered surface and most are protected by stipulation during exploration. Indirect impacts may be as important as direct impacts for plants and habitats. As noted earlier, indirect impacts would include the effects of erosion, changes in wildlife and livestock distribution, riparian community changes and the spread of noxious weeds.

Erosion from roads and drilling sites can indirectly affect vegetation from high runoff velocities scouring the plants from the site or by sediment burying the plants. The extent of this potential impact would be determined by the effectiveness of erosion-control measures and the level of enforcement of stormwater management plans. Plant community impacts would be in the same proportions as discussed under direct impacts. The basis of this analysis is formed from the assumption that installation of erosion-control procedures and effective enforcement of stormwater management plans would occur. Implementation of erosion-control measures and stormwater management plans would result in no long-term impacts from erosion. Short-term impacts are still likely to occur from thunderstorms during first few years and from 20 years of active roadbeds.

A total of 250 acres may be reclaimed following temporary disturbance at state-permitted wells. Failure to adequately restore these acres to pre-disturbance conditions would result in a loss of native habitat. Typical seeding mixes only include herbaceous species. Therefore, after reclamation and reseeding, there would be a change in the vegetative composition of the disturbed areas.. If reseeding is successful, it would potentially reduce noxious weed invasion, erosion and dust through restoration of plant cover.

TABLE 4-64

AMOUNT OF ACREAGE WITH UNDERLYING COAL BEDS IN EACH HABITAT TYPE (BY RMP AREA AND STATE LAND)[1]

Area	Grassland	Shrubland	Forest Land	Barren Land	Riparian[2]	Agricultural or Other Land Not Included as Native Vegetation
Powder River RMP area	1,537,000 (40%)	920,000 (24%)	908,000 (23%)	210,000 (5%)	170,000 (4%)	138,000 (4%)
Billings RMP area	1,022,000 (40%)	737,000 (29%)	377,000 (15%)	87,000 (3%)	98,000 (4%)	207,000 (8%)
MBOGC-regulated land	990,000 (56%)	152,000 (9%)	89,000 (5%)	75,000 (4%)	93,000 (5%)	359,000 (20%)

[1]Figure in parentheses indicates percentage of total acreage within the RMP area and MBOGC-regulated land.

[2]These acres are exempt from CBNG development as a result of stipulations that omit this type from consideration for CBNG exploration and development; they may be affected by water pollution and increased salinity.

TABLE 4-65

ACREAGE POTENTIALLY IMPACTED IN EACH HABITAT TYPE FOR ALTERNATIVE A (BY RMP AREA AND STATE-PERMITTED LAND[1])

Area	Grassland		Shrubland		Forest Land		Barren Land		Riparian		Other Areas	
	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary	Permanent	Temporary
Powder River RMP	80	0	48	0	46	0	10	0	8	0	8	
Billings RMP	80	0	58	0	30	0	6	0	8	0	16	
MBOGC-regulated land	420	140	68	23	38	13	30	10	38	13	150	50
Total*	580	140	174	23	114	13	46	10	54	13	174	50

*These estimates were arrived at using GIS data. Sweet Grass and Carter counties did not have enough bituminous coal beds to show up on those layers, therefore CBNG well data for those two counties are not included in these estimates. The total acres of impact using GIS data are 1,391 acres. Total real impacts for all counties are estimated to be 1,488 acres.

[1] MBOGC regulated

CBNG exploration activities could result in the recruitment of noxious weeds by disturbing present vegetative cover, compacting soil, exposing mineral soil to seed fall and aiding the migration of seeds through movement of vehicles and drilling equipment from site to site. Noxious weeds can indirectly impact native vegetation by out-competing native plants for scarce nutrient, light and water resources, thereby displacing the native species. Sites with the greatest potential for noxious weed invasion, erosion, or difficulty in restoring to pre-disturbance vegetation are generally sites with pre-existing weed problems or drier sites, such as those designated as barren land. Noxious weeds introduced into a forest environment would be very difficult to control because of access restrictions when weeds spread into deep drainages and timbered hills where chemical control would be difficult. Control of noxious weeds is addressed under current BLM stipulations or state law. The increase in the number and potential for spread of noxious weeds with disturbance is an important consideration even at the current level of exploration and development. This concern is related to other indirect impacts, such as lack of successful reclamation and erosion.

Roads are considered a major contributing factor to the continuing spread of exotic plant species. Improved roads can provide the means by which adjacent natural habitats are converted to ecosystems highly vulnerable to invasion by exotic plants. Various factors influence the susceptibility of communities farther from roads versus those along roads, including dominant vegetation, soil moisture, nutrient levels, soil depth, disturbance and topography. Plant communities appearing most vulnerable are those that are both physically conducive to invasion (e.g., having deep or fertile soils) and disturbed (Gelbard and Belnap 2003).

Species of concern include federally listed T&E and candidate species; Montana species of concern; BLM species of concern, and Montana Natural Heritage Program species of concern. For the state, this document addresses only those listed as category S1, which are species of extreme rarity or species for which some factor of its biology makes it especially vulnerable to extinction. The Vegetation Appendix, Table VEG-6 describes and lists all special-status species.

As discussed in the *Species of Concern* section of Chapter 3 in this EIS, there are no known federally listed threatened or endangered plant species in the Planning Area. In accordance with the ESA, any identified federally listed species and their habitat must be protected from possible impact by oil and gas and CBNG development on federal land, but not on state or private land. Additionally, 69 species are classified as "species of special concern" by the Montana BLM and the Montana Natural Heritage program. By policy, BLM management cannot impact these species in a way that may cause further declines in the species' population status.

Crow Reservation

CBNG development on the Crow Reservation is expected to be very limited. To the extent that it does occur, impacts to plant communities and natural vegetation would be similar to those described for private lands and would occur on a much smaller scale than on BLM or State lands.

Northern Cheyenne Reservation

CBNG development on the Northern Cheyenne Reservation is expected to be very limited. A study of methane gas development on Northern Cheyenne lands concluded that it would be uneconomical (Little Coyote 2001; Herco-Hampton 1989). To the extent development does occur, impacts to plant communities and natural vegetation would be similar to those described for private lands and would occur on a much smaller scale than on BLM-administered or State lands.

State Species of Concern

Direct and indirect impacts on other species of concern would be expected to some degree.

Conclusions

Up to 1,105 acres of native vegetation (excluding up to 20 riparian acres on BLM-administered surface) would be lost through CBNG exploration activities and an additional 250 acres would be temporarily disturbed. Unspecified impacts to native vegetation through livestock grazing would occur if displaced animals concentrate in certain areas. Shrub, forested and barren lands would not be adequately restored using the existing recommended seeding mix, which reseeds only grasses. For all habitats, some reclamation efforts may fail. Strict adherence to reclamation policies would result in no impact to vegetation from noxious weed infestations. However, these guidelines and regulations have been in place for many years and weeds continue to spread across central and eastern Montana. Therefore, some further infestations of noxious weeds would be expected. User-created roads would result in additional loss of vegetation and increased potential spread of noxious weeds (USDI and USDA 2001). No impacts on the Ute ladies'-tress would be expected.

Cumulative Impacts

Cumulative impacts may occur from coal mining operations. Coal mining occurs within the same area covered by this EIS. Vegetation will be destroyed within the disturbed area of a coal mine. As the mine area is reclaimed, topsoil is redeposited and reseeded to reestablish vegetation. Reseeding during reclamation activities will generally result in an increase in grasslands with less plant diversity than was present under pre-mining conditions.

Construction of the proposed Tongue River Railroad would result in the removal or disturbance of 328 to 456 acres of vegetation within the ROW. Vegetation within each of the three ROWs is a mixture of pine/juniper, grassland/sagebrush, agricultural, deciduous tree/shrub and breaks habitat. Revegetation would reduce the area of permanent disturbance (STB 2004).

During operations, principal impacts to vegetation would be caused by the use of herbicides to control weeds, range fires and possibly coal dust. The use of herbicides could damage native plant species and could increase the likelihood of range fires due to the presence of dead and dying vegetation. Local ranchers have expressed concern regarding the propagation of noxious weeds by passing trains, as well as the potential for railroad-caused range fires. In addition to being a fire hazard, weeds can reduce crop production (Surface Transportation Board 2004).

About 92 percent of the coal volume located in the Powder River basin occurs within Wyoming (Ellis et al. 1999b) and as many as 50,000 CBNG wells may be developed in the Wyoming portion of the basin. The direct and indirect effects of Wyoming CBNG development would far surpass the effects of CBNG development in Montana under Alternative A because of so many wells. Some rivers entering Montana from Wyoming would be expected to have higher flows, resulting in potential erosion of wetland and riparian communities and habitat degradation.

ESA provisions applied to other projects should avoid cumulative impacts to T&E wildlife species when considered in conjunction with CBNG exploration and development.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

As listed under Alternative A, four habitat types (grassland, shrubland, forest land and barren land) will be affected in varying amounts depending on the alternative and the amount of habitat with underlying coal beds. Well development is estimated at 18,300 wells in the RFD, but only 16,470 of these will be production wells. If these wells are distributed evenly over habitats by the proportion of habitats with bituminous coal beds, a total of approximately 55,360 acres would be directly impacted by production wells and dry hole drilling. Approximately 48,864 acres would occur on land with native vegetation: 21,446 acres of grassland vegetation, 13,214 acres of shrubland, 11,680 acres of forest land and 2,523 acres of barren land could be potentially impacted, if wells were distributed in proportion to the amount of acres in each habitat type. Direct impacts to riparian areas are similar to Alternative A.

Table 4-66 estimates the acres of direct impact for each action alternative based on information in Chapter 2.

TABLE 4-66

ACRES OF LAND AND LENGTH OF ROADS AND UTILITY CORRIDORS DIRECTLY IMPACTED BY NEW CBNG CONSTRUCTION

	Alternative				
	B and D	**C**	**E**	**F and H**	**G**
Area disturbed per well[1, 2]	3.25 acres	4.14 acres	4.14 acres	3.25 acres	3.25 acres
Length of roads per well[2]	0.237 miles	0.365 miles	0.365 miles	0.237 miles	0.237 miles
Length of utility corridor per well[3]	0.734 miles	1.13 miles	1.13 miles	0.734 miles	0.734 miles
Number of wells[2]	18,300	18,300	18,300	18,225	6,470
Total area directly disturbed[3,4]	55,360 acres	70,015 acres	73,860 acres	59,045 acres	21,035 acres
Length of CBNG roads per square mile[2, 4]	2.9 to 8.8 miles	3.9 to 11.9 miles	3.9 to 11.9 miles	2.9 to 8.8 miles	2.9 to 8.8 miles
Total length of CBNG roads[1, 2]	6,680 miles	9,018 miles	9,018 miles	6,662 miles	2,375 miles
Length of pipeline and utility corridors per square mile[3,5]	9.04 to 27.12 miles	12.2 to 36.61 miles	12.2 to 36.61 miles	9.04 to 27.12 miles	9.04 to 27.12 miles
Total length of pipeline and utility corridors[1, 3]	20,679 miles	27,917 miles	27,917 miles	20,623 miles	7,345 miles

[1]The land area disturbed and the length of roads and corridors would be 27 percent greater for Alternatives C and E than for Alternatives B, D, F and H because transportation corridors and the use of existing disturbed lands would not be required for roads and utilities under Alternatives C and E.

[2] Short-Term.

[3] Long-Term.

[4] Area of direct disturbance for Alternative E is greater than Alternative C to account for the 3,700 wells requiring water basin impoundment structures. Alternatives F, G and H also account for water basin impoundment structures.

[5]Length of roads, pipelines and utility corridors per square mile covers the range of 8 to 24 wells per square mile of land overlying 1 to 3 coal seams, respectively. At an average of 8 wells per square mile, 2,287 square miles (2281 square miles for Alternative F and H, 813 for Alternative G) would be impacted by intensive CBNG development. At 24 wells per square mile, 762 square miles (760 square miles for Alternative F, 271 for Alternative G) would be impacted by intensive CBNG development. Additional wildlife habitat surrounding well fields would be indirectly impacted by human activities and presence.

Direct vegetation loss by habitat type is assumed to be proportional to the relative amount of each habitat type shown in Table 4-64.

As discussed in the *Wildlife* section, water production and roads can alter the distribution of wildlife and livestock. As wildlife or livestock use is concentrated due to those factors, plant communities can be altered through overgrazing. Overgrazing tends to favor establishment and reproduction of annual and invasive plant species. These species tend to displace native plant assemblages. To the extent grazing animals concentrate in smaller areas, plant communities would change to less diverse, introduced plant communities. Most county weed control efforts focus on herbicide spraying, which reduces plant diversity even more.

Indirect effects include changes in wildlife and livestock distribution patterns as a result of machinery disturbance or removal of habitat.

When disturbance removes vegetative cover from soil, it is open to erosion from wind and water. Erosion from roads and drilling sites can indirectly affect vegetation from high runoff velocities scouring plants from the site or by sediment burying the plants. The extent of this potential impact would be determined by the effectiveness of erosion-control measures and the stormwater management plans. Types of plant community impacts would be in the same proportions as discussed above but on a much greater scale than for Alternative A.

Existing hydrology and riparian vegetation would not be affected by build-up of salts with this alternative because of the use of injection and holding tanks for production water. The potential for spreading noxious weeds is substantially greater than under Alternative A because 20 times as much land would be disturbed.

Species of Concern-Federally Listed Species

Direct impacts to federally protected species are prohibited by law and would not occur under Alternative B, which is the same as under Alternative A, because none have been reported in the Planning Area.

The potential for direct and indirect impacts on other species of concern would be much greater under this alternative because of the much larger amount of habitat that will be disturbed or lost with the increased level of vegetation disturbance associated with the greater number of well pads, roads, pipelines and utility lines. More roadways provide greater access and more potential for disturbance of protected species.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B. If there were no CBNG development on tribal Lands, then there is expected to be minimal, impacts on vegetation for the reservation. If there is CBNG development on the reservation, then the acres of disturbed habitat could be inferred to the reservation using the same approach used in this section.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Conclusions

The impacts of CBNG development under Alternative B would be substantially greater than under Alternative A because 20 times as many wells would be developed and 20 times as much area would be disturbed.

Reclamation after well abandonment on 44,000 acres may revegetate well sites and roads, but not necessarily restore the sites to previous vegetation or habitats, resulting in native habitat loss.

Cumulative Impacts

Cumulative impacts would be the same as described for Alternative A except that Montana CBNG development impacts would be greater.

Alternative C—Emphasize CBNG Development

A total of approximately 70,015 acres would be directly impacted. Approximately 62,238 of this acreage would be on sites with native vegetation cover. Approximately 27,316 acres of grassland vegetation, 16,831 acres of shrubland, 14,877 acres of forest land and 3,214 acres of barren land could be potentially impacted, if wells were distributed in proportion to the amount of acres in each habitat type. Direct impacts to riparian areas are similar to Alternative A. In addition, although no wells will be authorized in riparian areas under any alternative, the discharge of untreated water from exploration and production onto the surface could affect riparian vegetation, perhaps as much as 3,535 acres. This is the estimated average total acreage of habitat with riparian vegetation that is underlain by bituminous coal bed (BLM and state).

Indirect impacts would include the impacts noted earlier of noxious weed invasion, erosion and changes in wildlife and livestock distribution. In addition, indirect impacts would include increased SAR and salinity levels, which could result in riparian community changes and increased erosion potential for wetland and riparian communities.

Alternative C has the greatest potential for erosion because of the increased disturbance area with no restrictions on corridors for pipelines, utilities and roadways and no requirements for directional drilling or multiple completions in a single well. The extent of erosion would be determined by the effectiveness of erosion-control measures and the stormwater management plans. This alternative will potentially increase the area of disturbance over Alternatives B or D by approximately 15,000 acres (Table 4-66). This acreage increase will increase the potential for erosion.

With discharge of the CBNG water to surface drainages and streams, erosion could occur, which could damage or destroy instream and streambank riparian vegetation (Regele and Stark 2000). The erosion could result in increased sediment loads that, along with the potential high salinity and sodicity, could degrade the stream and impact riparian vegetation. Impacts of discharging CBNG waters would likely be greatest in intermittent and smaller perennial drainages during low-flow periods. Releases during low-flow periods of late summer and fall would have the greatest potential to impact riparian vegetation. This is also the time when this vegetation is naturally stressed because of low water. The potential for impacts on riparian vegetation

exists along drainages and streams throughout the CBNG development area.

CBNG groundwater discharge has an SAR capable of killing vegetation (Regele and Stark 2000). Plant growth is affected in sodic soils due to decreased soil permeability, increased pH (which lowers nutrient availability) and accumulation of certain elements (sodium, boron and molybdenum) at a level toxic to plants. Because of the typically low flows of the CBNG wells (approximately 5 to 10 gallons per minute), it is likely that these SAR impacts would be localized in the vicinity of the discharge, unless flow were collected from a large number of wells.

Species of concern have a higher potential for direct and indirect impacts compared to Alternative B because of more surface disturbance.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Conclusion

Reclamation of vegetation after well abandonment may revegetate well sites and roads, but not necessarily restore the sites to previous vegetation or habitats, resulting in native habitat loss.

Localized increases in salinity and SAR values may be the most important aspect of this alternative. Salinity can have long-term effects on vegetation, including changes in species composition to more salt-tolerant species and high concentrations of salt in riparian soils. Soil impacts may last long after a given project site has been abandoned. Increased SAR values may prevent nonhydrophytic reclamation vegetation from succeeding. Increased roads result in more land being disturbed, more wildlife and livestock forage will be removed and more area for noxious weed invasion being present.

All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through increased roads and/or by changing streambed hydrology and increased SAR and salinity values in water and soil.

Cumulative Impacts

The types of cumulative impacts are the same as discussed under Alternative A. Disturbed habitat quantities would be similar to those described in Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts

Impacts on habitat types under this alternative would be the same as Alternative B except for the potential for riparian impacts. Although no wells will be authorized in riparian areas on BLM-administered surface under any alternative, the discharge of water from exploration and production onto the surface could create riparian areas that will be abandoned and could affect the hydrology of current riparian areas, perhaps as much as 2,776 acres.

Under this alternative, indirect impacts could include the impacts noted earlier of noxious weed invasion, erosion and changes in wildlife and livestock distribution. In addition, indirect impacts would likely include increased water being added to riparian systems, which could affect riparian vegetation. Reservoirs that are used in this alternative for holding treated water could produce problems when they are abandoned. Riparian vegetation that developed during the operation dies after abandonment and the bed of the drying reservoir tends to become infested with noxious weeds (Lahti 2001).

Erosion potential may increase under this alternative because there are no reclamation requirements for roadbeds. This is offset somewhat by the stipulation that no slopes greater than 30 percent can be used for CBNG construction.

Discharge of water from exploration and production onto the surface could affect the hydrology of as much as 2,776 acres of current riparian vegetation.

Species of concern could be impacted as described for Alternative B and by discharge of CBNG water.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative D.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Conclusions

There is no requirement for road abandonment so long-term impacts caused by removal of vegetation for roadways is not known, but would occur. Stipulations concerning slope of land for potential CBNG sites are likely to protect such slopes from failure and mass wasting problems. A secondary effect is that such areas will remain in their existing habitat and plant communities. Reclaimed areas may revegetate adequately, but this will not restore the sites to previous native vegetation or habitats. There is potential for habitat loss because of the lack of requirements for roadbed reclamation or for abandoned reservoirs. Areas that are not reclaimed would represent a permanent loss of native vegetation and be subject to noxious weed infestations.

All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered with reclamation after well abandonment, by increased access through user-created roads, or by changing streambed hydrology and increased SAR and salinity values in water and soil.

Cumulative Impacts

Cumulative impacts from Alternative D would be the same type of impacts as described for Alternative A. The quantity of disturbed habitat would be the same as discussed under Alternative C.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Impacts

The same types of impacts to vegetation and species of concern described for Alternative C would occur under Alternative E because no additional specific mitigation measures will be required and because transportation corridors will not be required. There will be additional impacts in addition to those for Alternative C for the 3,700 wells that will have water basin impoundment structures. This will increase area of total impacts to approximately 73,860 acres. Of this, approximately 66,457 acres of native vegetation will be impacted, 29,168 acres of grassland, 17,972 acres of shrubland, 15,885 acres of forest land and 3,432 acres of barren land.

This Alternative would require a Water Management Plan for every well exploration APD on a site-specific basis for management of production water. There would be no discharge of produced water, either treated or untreated, into the watershed under this alternative unless the operator can demonstrate in the Water Management Plan how discharge could occur without damaging the watershed in accordance with water quality laws. Water quality laws will not protect riparian vegetation from inundation and other changes in the water level as a result of production.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for this Alternative.

Specific mitigation measures proposed by the Northern Cheyenne Tribe that will be implemented by the BLM are described in the Northern Cheyenne Tribe Mitigation Appendix.

Conclusions

Residual impacts would be the same as described for Alternative C. All species of concern that are not federally protected may be impacted by habitat changes caused by vegetation removal that are not fully recovered after well abandonment and by increased access through increased road densities, which may cause greater disturbance and noxious weed infestations.

Cumulative Impacts

The cumulative impacts from Alternative E would be the same types of impacts as described for Alternative A. The quantity of disturbed habitat would be the same as discussed under Alternative C.

Alternative F—Phased Development Multiple Screens (High Range)

Impacts

The area of surface disturbance for Alternative F, in which vegetation and species of concern could be impacted, is expected to be approximately 59,100

acres, which is slightly higher than Alternative B but less than Alternative E (Table 4-66). As under Alternative E, this alternative would require development of PODs in consultation with tribes, surface owners and other involved permitting agencies. Each of these Project Plans would include a site-specific Reclamation Plan, Wildlife Monitoring Plan, Surface Use Plan, Noxious Weed Management Plan and Water Management Plan. Unlike Alternative E, this alternative would use watershed-level analysis to evaluate resource effects from CBNG and other activities occurring within the affected watersheds.

The allowable development in the crucial sage-grouse habitat areas would likely be less dense than the typical 80-acre well-site spacing and if no development were to occur in these areas, overall impacts to vegetation would be reduced by approximately 12.8 percent. This would reduce the amount of disturbed vegetation by approximately 7,565 acres.

Additionally, annual and watershed-specific limits on the number of federal CBNG wells developed would reduce the impacts that would otherwise occur under the other development alternatives during the initial years of the planning period. The resultant rate of development would provide a more even level of impacts as most of the predicted state wells are developed in the first half of the planning period and more of the predicted federal CBNG wells are developed in the latter half. Additionally, vegetation disturbance may be reduced based on results of the watershed-level analysis used to evaluate development proposals. Disturbance in individual watersheds would be limited to prevent the potential for fragmentation of habitat for species of concern.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative F. Project Plans of Development requiring consultation with tribes, resource protection protocols based on watershed-level analysis and monitoring of development within a 5-mile buffer around the Reservation would provide additional opportunities for protection of Reservation resources.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation.

Specific mitigation measures proposed by the Northern Cheyenne Tribe that could be implemented by the BLM are described in the Northern Cheyenne Tribe Mitigation Appendix.

Conclusions

Residual impacts would be similar to Alternative B, except that they would occur more evenly during the 20-year planning period. Site-specific Project Plans of Development and watershed-level of analysis would likely reduce potential effects to species of concern under Alternative F relative to Alternatives B through E.

Cumulative Impacts

The cumulative impacts from Alternative F would have similar types of impacts as described for Alternative B. However, the quantity of disturbed habitat would be slightly higher than Alternative B, because of additional water basin impoundment structures required for Alternative F (Table 4-66). However, the timing and location of habitat disturbance would vary for this alternative versus Alternatives B through E due to the annual and watershed-based limits imposed on federal well development.

Alternative G—Phased Development Multiple Screens (Low Range)

Impacts

The area of surface disturbance for Alternative G, in which vegetation and species of concern may be impacted, is expected to be approximately 21,100 acres, which is less than Alternative F because the number of wells and the resulting area of disturbance would be approximately 65 percent less. The types of impacts of Alternative G would be similar to Alternative F, because both alternatives would use watershed-level analysis to evaluate resource effects from CBNG and other activities occurring within the affected watersheds.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative G.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation.

Conclusions

The impacts from Alternative G would be the same types of impacts as described for Alternative F, but would occur over a 65 percent smaller area.

Cumulative Impacts

The cumulative impacts from Alternative G would be the same types of impacts as described for Alternative F, but would be less because of the smaller affected area.

Alternative H—Preferred Alternative - Multiple Screens

Impacts

Alternative H is the BLM's Preferred Alternative for the development of CBNG resources on BLM-administered lands. Alternative H will review CBNG proposals against four resource screens. This Alternative would also require PODs that include mitigation measures. The resource screens would be applied to water resources, wildlife, Native American concerns and air resources. The screens would be implemented with the goal of monitoring impacts and developing a decision-making process to control and reduce impacts before they become unsustainable.

Of the four screens only the wildlife and water screens would directly affect vegetation. The air screen would not affect vegetation, while the Native American screen could indirectly affect vegetation on Native American lands by addressing discharge of groundwater onto surface vegetation and protecting Indian Trust Assets.

The area of surface disturbance for Alternative H, in which vegetation and species of concern could be impacted, is expected to be approximately 59,100 acres, which is similar to Alternative F, higher than Alternative B, but less than Alternative E. As under Alternatives E and F, the PODs would be developed in consultation with tribes, surface owners and other involved permitting agencies. Each of the PODs would include a site-specific Reclamation Plan, Wildlife Monitoring Plan, Surface Use Plan, Noxious Weed Management Plan and Water Management Plan. BLM would continue to implement the concept of adaptive management by using data from studies, monitoring and inspections to guide approvals of federal lease operations. POD requirements, the use of state and federal permits, lease stipulations, as well as the use of surface owner agreements and other management actions as described in Alternative E would also be features of this alternative.

Like Alternative F, Alternative H would use watershed-level analysis to evaluate resource effects from CBNG and other activities occurring within the affected watersheds. Vegetation disturbance may be reduced based on results of the watershed-level analysis used to evaluate development proposals. Disturbance in individual watersheds would be limited to prevent the potential for fragmentation of habitat for species of concern.

The combined numerical limits for cumulative and watershed development, coupled with the disturbed habitat limit would necessitate a varied geographical development and corresponding vegetation disturbance pattern across the CBNG Planning Area. Only a few watersheds (Upper Tongue, Lower Tongue, Middle Powder and Little Powder) would likely be developed in the initial three to five year period, while the remaining watersheds would be developed in later years.

Operators would be required to include noxious weed management plans in their PODs to prevent the spread of noxious weeds. The noxious weed management plans must include measures to prevent the spread of weed seeds from any vehicles and equipment from or prior to mobilization to the project area. In the reclamation plans, early serial plants would be specified for revegetation to provide a quick cover before noxious weeds could become established.

Indirect effects to vegetation would be similar to Alternative B through F, but would be reduced by the mitigation measures included in the PODs. Habitat could be disturbed or lost with the vegetation disturbance associated with well pads, roads, pipelines and utility lines. Roadways would provide greater access and more potential for disturbance, illegal harvest, or harassing of protected species.

Crow Reservation

Impacts to the Crow Reservation would be similar to those described in general for Alternative H. Operator PODs requiring consultation with tribes would be developed for all proposed CBNG development within 5 miles of the Crow Reservation. BLM would require site-specific groundwater and air analyses submitted as part of the operator's POD. Resource protection protocols and mitigation measures based on watershed-level analysis and monitoring of development would provide additional opportunities for protection of reservation resources.

Northern Cheyenne Reservation

Impacts to the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation. Specific mitigation measures proposed by the Northern Cheyenne Tribe that could be implemented by the BLM are described in the Northern Cheyenne Tribe Mitigation Appendix.

Conclusions

Residual impacts would be similar to Alternative F. Site-specific PODs, watershed-level of analysis and multiple screens would likely reduce potential effects to species of concern under Alternative H relative to Alternatives B through F. Reclamation after well abandonment may revegetate well sites and roads, but not necessarily restore the sites to previous vegetation or habitats, resulting in native habitat loss.

Cumulative Impacts

The area of habitat disturbance and the types of cumulative impacts from Alternative H would be the same as described for Alternative F. However, the timing and location of habitat disturbance would vary for this alternative versus Alternatives B through E due to the watershed-based limits and multiple screens imposed on federal well development for Alternative H. Cumulative impacts may occur from coal mining operations within the Planning Area and the proposed Tongue River Railroad in addition to proposed CBNG development. Vegetation would be destroyed within the disturbed area of each coal mine and reclamation will generally result in an increase in grasslands with less plant diversity than was originally present. The proposed TRR would result in the disturbance of approximately 513 to 542 acres of vegetation. CBNG development in Wyoming may increase flows of rivers entering Montana, resulting in potential erosion of wetland and riparian communities and habitat degradation.

Visual Resource Management

Visual Resource Management *Visual resources include Montana features such as landform, water, vegetation, color, adjacent scenery, uniqueness, structures and man-made features of aesthetic value*
Alternative A **No Action (Existing CBNG Management)**
• Federal and State: – Dust emissions would reduce visibility to a small degree near active field operations – Well pads, roads and compressors would disrupt the visual landscape. Semi-permanent structures are designed to blend into the surrounding environment – Drill rigs, two-track trails, heavy road-making equipment and generators would disrupt the visual landscape short-term
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• There would be impacts to BLM VRM Class III and IV areas only. • Type of impacts common to Alternative A would occur under Alternative B, at a scale commensurate with development. • View shed impacts from road network could last for 20 years until reclamation occurs.
Alternative C **Emphasize CBNG Development**
• Impacts common to Alternative B would occur with Alternative C, in addition to the following: – Above ground power lines would greatly impact skyline and viewshed. – Visual impacts from roads and utility lines are greatest with this alternative.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• Impacts common to Alternative B would occur with Alternative D, in addition to the following: – Production related roads that are not reclaimed and made part of the permanent road network would result in permanent visual impact.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• Impacts would be reduced by the mitigation measures in the Project Plan for visual resources.
Alternative F **Phased Development Multiple Screens (High Range)**
• Impacts would be similar to Alternative E. • Locations and amounts of impacts would vary compared to the other alternatives based on annual and watershed-based federal CBNG development limits.
Alternative G **Phased Development Multiple Screens (Low Range)**
• Impacts would be similar to Alternative F in the sequence of development but would result in lower impacts than the other action alternatives.
Alternative H **Preferred Alternative - Multiple Screens**
• Impacts would be similar to or less than Alternative F in the sequence of development, but could result in lower visual impacts than the other alternatives due to the screening process and use of mitigation and management plans for development.

Assumptions

Based on the Visual Resource Management (VRM) class, BLM stipulations and conditions of approval would require special design, including location, painting and camouflage, to blend with the natural surroundings and meet visual quality objectives for the area. A standard component typically includes painting facilities to camouflage them and a standard color may be specified.

Impacts From Management Common to All Alternatives

Visual resources would be impacted to varying degrees by oil and gas exploration and production activities. Exploration would involve minor visual impacts from clearing operations for access to exploratory sites. The majority of this impact would be expected to result from access road construction, site construction, drill rig operations and on-site generator use. Short-term visual impacts would occur where construction and drilling equipment is visually evident to observers. Long-term impacts would occur from construction of roads and pads, installation of facilities and equipment, vegetation removal and change in vegetation communities. These would produce changes in landscape line, form, color and texture.

Impacts would occur locally on a case-by-case basis as the native vegetation is disturbed and small structures are erected. Landscape line, form, color and texture would all be expected to change. The view to travelers throughout much of the Powder River area is a high plain with low-lying scrub-shrub vegetation and periodic rock outcrops. In the Castle Rock Project, there is rough terrain, high hills and buttes and timber present. Much of the area is very scenic and quite a contrast to the landscape of open prairie that might be found in other areas of the Powder River Basin. Visual impacts may include building roads in rough terrain or cutting timber.

Introducing man-made structures into this landscape, although small and painted for camouflage, changes the overall nature of the visual resource.

Four thousand acres of surface mining expansion under permit consideration may be approved this year. This mining activity may affect some visual resources in those areas for the next 20 to 30 years.

Construction and operation of the Tongue River Railroad would result in additional cumulative impacts to visual resources. The overall purpose of the proposed rail line is to transport coal from mines in the Powder River Basin and Tongue River Valley to markets in the Midwest and northeastern states. Analysis of the proposed project concluded that there would be very low to moderate long-term impacts to the scenic quality of the landscape along much of the approximately 130 miles of proposed route. Visual impacts would result from construction of fill prisms in several locations and from visibility of trains from sensitive areas. Impacts from construction of fill prisms would be designed so that the cuts would fit with natural contours and surrounding environment and then planted. Additional short-term impacts would occur as a result of construction activities.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

CBNG production well activities would have visual impacts. CBNG wells, typically covered in a box, or "housing" for protection from weather, are isolated structures approximately 4 feet high by 4 feet wide by 4 feet long. The wells are scattered across a wide area and are connected to field compressors. The compressors are larger and create more of a visual impact-although in a much smaller area because these structures are more widely distributed. Compressors range in size from field compressors at 8x12x8 (width, length, height; in feet) to sales compressors at 12x18x10. Visual impacts also would arise from construction activities related to developing access to the sites. Exploration well activities may have short-term visual impacts if the exploration wells are not converted to production wells. These short-term impacts (approximately 2 months) would be from the visual effects of the drill rig, portable generator and access road.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. If there were no CBNG development on tribal lands, then there is expected to be minimal, if any, impacts on visual resources for the reservation.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Exploration wells would cause short term impacts and impacted areas will be repaired on an as-needed basis. Minimal permanent visual impacts (approximately 500 acres) are anticipated within the CX Ranch due to well houses, compressor stations, power lines and associated roads.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Visual impacts would occur from the development of CBNG wells in this alternative for lands in VRM Classes III and IV. VRM Class I and II lands would not be developed and the No Surface Occupancy stipulation applies. The Controlled Surface Use stipulation would be applied to Class III and IV lands. On lands without VRM objectives, a Visual Resource Inventory and Visual Contrast Rating would be accomplished, on a case-by-case basis, to determine the VRM class, visual qualities, site specific impacts and mitigation. On lands with VRM objectives, a Visual Contrast Rating would be completed, on a case-by-case basis, to determine site specific visual impacts and mitigation. Impacts from utilities would be minimal as power lines are buried and other utilities are concentrated within roadway corridors.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Residual visual impacts would include the impact of the expanded road network when viewed from a distance or from higher elevations. Cumulative

impacts would include the visual impact of additional roads when combined with existing roads and new roads being constructed for other uses.

Alternative C—Emphasize CBNG Development

For Alternative C, visual impacts would occur from the development of CBNG wells for lands in VRM Classes II, III and IV. VRM Class I lands would not be developed and the No Surface Occupancy stipulation would apply. The Controlled Surface Use stipulation would be applied to Class II, III and IV lands. On lands without VRM objectives, a Visual Resource Inventory and Visual Contrast Rating would be accomplished, on a case-by-case basis, to determine the VRM class, visual qualities, site specific impacts and mitigation. On lands with VRM objectives, a Visual Contrast Rating would be completed, on a case-by-case basis, to determine site specific visual impacts and mitigation.

Power lines would be aboveground in this alternative and roads would be allowed to be placed according to operator plans. This would result in power lines where none now exist, as well as a wider expanse of roads.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Residual visual impacts would include the impact of the expanded road network when viewed from a distance or from higher elevations. There also would be a network of power lines visible from many places.

Cumulative impacts would be the same as described for Alternative B.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Visual impacts would be the same as described for Alternative B.

Conclusions

Residual and cumulative impacts are the same as described for Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Visual impacts would occur from the development of CBNG wells for lands in VRM Classes II, III and IV. VRM Class I lands would not be developed and the No Surface Occupancy stipulation would apply. The Controlled Surface Use stipulation would be applied to Class II, III and IV lands providing options for lessening the visual impact through design and landscape features. On lands without VRM objectives, a Visual Resource Inventory and Visual Contrast Rating would be accomplished, on a case-by-case basis, to determine the VRM class, visual qualities, site specific impacts and mitigation. On lands with VRM objectives, a Visual Contrast Rating would be completed, on a case-by-case basis, to determine site specific visual impacts and mitigation. Visual contrast Ratings would be completed at the APD or POD stage to identify site specific impacts and determine mitigation.

This alternative does allow for installation of pipelines, power lines and roads where there are none now. But, it also requires that the operator minimize or mitigate impacts from these activities in the Project Plan and state how the surface owner was consulted for input on the location of roads, pipeline and utility line routes. It also allows, at the surface owner's discretion, the closing and rehabilitation of roads or the option of leaving them open, after well abandonment.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Use of the mitigation plan as part of the Project Plan would lessen many of the visual impacts but would not eliminate them. New roads and power lines

would be a residual visual impact from this alternative.

There would be cumulative visual impacts from the combination of new and existing roads and utilities.

Alternative F—Phased Development Multiple Screens (High Range)

Overall visual impacts at the end of the 20-year development cycle would be similar to Alternative E because both alternatives will have approximately the same cumulative level of development. Based on the sequence of development predicted for this alternative, visual impacts from federal CBNG development would be lower during the first few years of the planning period than any of the other action alternatives. Impacts would accumulate each year thereafter as the number of developed wells increases. Since development is distributed over several watersheds, those with the greatest number of developed wells would experience the greatest visual impacts from federal CBNG development. The greatest effects due to federal development are predicted to be in the Lower and Upper Tongue, Middle Powder and Rosebud watersheds. Cumulative impacts will result over time and within the watersheds as both federal and state/private CBNG well development occurs.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described for Alternative E.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Use of management and mitigation plans would lessen many of the visual impacts but would not eliminate them. New roads and aboveground power lines would be a residual visual impact from this alternative. As with Alternative E, short-term construction impacts would be greater than the long-term impacts because the footprint of each well is smaller than the necessary construction footprint.

Cumulative impacts would be similar to those described under Alternative E.

Alternative G—Phased Development Multiple Screens (Low Range)

Overall visual impacts at the end of the 20-year development cycle would be noticeably less than those of Alternative F because Alternative G would result in approximately one-third the number of developed wells. Alternative G would be similar to Alternative F in the sequence of development predicted for this alternative. Impacts would accumulate each year thereafter as the number of developed wells increases. Since development is distributed over several watersheds, those with the greatest number of wellheads would experience the greatest visual impacts from federal CBNG development. As with Alternative F, the greatest effects due to federal development are predicted to be in the Lower and Upper Tongue, Middle Powder and Rosebud watersheds. Cumulative impacts will result over time and within the watersheds as both federal and state/private development occurs.

Crow Reservation

Impacts on the Crow Reservation would be similar in nature to those described for Alternative F; however the amount of impacts would be approximately one-third of Alternative F due to limited well development under Alternative G.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusions

Use of management and mitigation plans would lessen many of the visual impacts but would not eliminate them. New roads and aboveground power lines would be a residual visual impact from this alternative. As with Alternative F, short-term construction impacts would be greater than the long-term impacts because the footprint of each operating well is smaller than the necessary construction footprint.

Cumulative impacts would be less than those described under Alternative F due to the reduced amount of well development.

Alternative H—Preferred Alternative - Multiple Screens

Overall visual impacts would be similar to or less than Alternatives E and F. Based on a sequence of

development similar to that predicted for Alternative F, visual impacts from federal CBNG development under Alternative H would be lower during the first few years of the planning period than Alternatives B through E. Impacts would accumulate each year thereafter as the number of developed wells increases. Since development is distributed over several watersheds, those with the greatest number of developed wells would experience the greatest visual impacts from federal CBNG development. The greatest effects due to federal development are predicted to be in the Lower and Upper Tongue, Middle Powder and Rosebud watersheds. Cumulative impacts will result over time and within the watersheds as both federal and state/private CBNG well development occurs.

Visual consequences under Alternative H could be less than the other alternatives because each proposal for development would be subject to review against the four resource screens (air, water, wildlife, Native American concerns), as well as planning and mitigation requirements. This review process would balance CBNG development with protection of the natural environment. While visual resources do not have an individual screen for the review process, it is considered in the individual analyses. Additionally, key environmental and wildlife conditions are subject to the resource screens. Protection of these conditions would contribute to a more natural-appearing visual character.

Visual impacts due to erosion from CBNG-produced water could be less than Alternatives C, D and E and similar to Alternative F because the BLM would require a water management plan and use watershed-based thresholds for the volume of untreated water that could be discharged to surface waters from federal CBNG wells.

Visual disturbance could be less than Alternatives E or F because there would be minimal road construction. Transportation corridors (proposed roads, flowline routes and utility line routes) would be located to follow existing routes, or areas of previous surface disturbance, where possible. In addition, low-voltage distribution power lines would be buried.

Cumulative impacts would result within the watersheds as both federal and state/private development occurs. However, Alternative H includes watershed-level analysis as part of POD development and review to evaluate and address cumulative impacts as they are identified.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative H. If there were no CBNG development on tribal lands, then there are expected to be minimal, if any, impacts on visual resources for the reservation. The Native American concerns screen would provide an additional level of resource protection for development proposed within 5 miles of the reservation and in the vicinity of traditional cultural properties through consultation with the tribe and monitoring during development.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation under this alternative.

Conclusion

Use of the screening process and management and mitigation plans would lessen many of the visual impacts, but would not eliminate them. A limit on new roads construction and putting power lines underground would help maintain the natural-appearing landscape.

As with the other alternatives, short-term construction impacts would be greater than the long-term impacts because the footprint of each operating well is smaller than the necessary construction footprint.

Cumulative impacts would include the visual impact of additional roads, if any, when combined with existing roads and new roads being constructed for other uses.

Wilderness Study Areas

Wilderness Study Areas *There are 6 WSAs within the CBNG emphasis area*
Alternative A **No Action (Existing CBNG Management)**
• BLM WSAs are closed to oil and gas leasing so there would be no direct impact to WSAs. Because there would be no production activities in BLM planning areas under this alternative, there would be no impacts.
Alternative B **CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources**
• No direct impact to WSAs from CBNG development.
Alternative C **Emphasize CBNG Development**
• No direct impact to WSAs from CBNG development.
Alternative D **Encourage CBNG Exploration and Development While Maintaining Existing Land Uses**
• No direct impact to WSAs from CBNG development.
Alternative E **CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses**
• No direct impact to WSAs from CBNG development.
Alternatives F & G **High and Low Range Phased CBNG Development**
• No direct impacts to WSAs from phased CBNG development.
Alternatives H **Preferred Alternative - Multiple Screens**
• No direct impacts to WSAs from CBNG development.

Assumptions

Wilderness Study Area (WSA) policy prohibits leasing of WSA lands for resource extraction subject to rights associated with valid claims and leases existing at the time of designation.

Impacts From Management Common to All Alternatives

BLM leasing restrictions are designed to protect WSAs from considerable impact. The WSA policy prohibits leasing of these lands for resource extraction. It is expected that WSAs will not be impacted through conventional oil and gas development under current management. Remote areas may be accessed as CBNG development proceeds, but this does not mean that WSAs will be impacted. Specific potential impacts to WSAs cannot be quantified until specific development proposals are received.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

State and private lands would be impacted by CBNG production activity. There would be no production activities in BLM planning areas under this alternative and therefore no impacts from CBNG activities.

Conclusion

Impacts from this alternative would be similar to management common to all alternatives. Since stipulations for WSAs prevent leasing of these lands for resource extraction, there are expected to be no major impacts to WSAs.

There are no cumulative impacts from CBNG development.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Alternative B would allow development while emphasizing the protection of natural and cultural resources. Under this alternative development would result in increased access to remote areas. The impacts from this alternative would be similar to those described under *Impacts From Management Common to All Alternatives*.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative C—Emphasize CBNG Development

Alternative C would emphasize CBNG exploration and development with minimal restrictions. The impacts from this alternative would be similar to management common to all alternatives.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Alternative D would encourage CBNG development while maintaining existing land uses and protecting downstream water consumers. The impacts from this alternative would be similar to management common to all alternatives.

Conclusion

Impacts from this alternative would be similar to those described under Alternative A.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Alternative E would allow CBNG development subject to existing planning restrictions and balances CBNG development and the protection of the natural environment. The impacts from this alternative would be similar to those described under *Impacts From Management Common to All Alternatives*.

Conclusion

There are no cumulative impacts from CBNG development.

Alternative F—Phased Development Multiple Screens (High Range)

Alternative F would allow CBNG development subject to watershed level planning coupled with phased development. The impacts from this alternative would be similar to those described under *Impacts From Management Common to All Alternatives*.

Conclusion

There are no cumulative impacts from CBNG development.

Alternative G—Phased Development Multiple Screens (Low Range)

Alternative G would be the same as Alternative F in that it would allow CBNG development but at a lower number of allowed federal APDs.

Conclusion

There are no cumulative impacts from CBNG development.

Alternative H—Preferred Alternative - Multiple Screens

Alternative H would allow CBNG development subject to multiple screens, increased monitoring and long-term corridor planning.

BLM leasing restrictions are designed to protect WSAs from considerable impact. The WSA policy prohibits leasing of these lands for resource extraction. It is expected that WSAs will not be impacted through CBNG development.

Mitigation

There are no mitigation measures necessary since no development is current allowed within WSAs.

Conclusion

There are no cumulative impacts to WSAs from regional projects as forecasted at this time.

Wildlife

Wildlife

Mammal Species: 10 bats. 8 shrews, 34 small mammals and lagomorphs, 17 predators, 4 big game,
Bird Species: 32 waterfowl, 33 shore & wading birds, 18 diurnal & 11 nocturnal raptors, 8 gallinaceous, 8 wood peckers, 137 songbirds
Reptiles and Amphibian species: 1 salamander, 4 frogs, 4 toads, 3 turtles, 2 lizards, 9 snakes
Species of Concern consist of 16 mammals, 9 reptiles and amphibians, and 22 birds, including: Sage-grouse, Mountain Plover, Bald Eagle, Interior Least Tern, Peregrine Falcon, Gray Wolf, Black-tailed Prairie Dog, Canada Lynx, Black-footed Ferret, Grizzly Bear

Alternative A
No Action (Existing CBNG Management)

- Direct impacts include habitat loss, death from vehicle collisions and effects associated with greater human access into previously untraveled areas.
- Indirect impacts on wildlife include disturbance and displacement, stress, power lines, noxious weed invasion, user-created roads, habitat fragmentation, water quality degradation from road runoff and increased livestock grazing.
- Indirect impacts on wildlife would occur on 33,840 to 84,000 acres.
- Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest or collisions with vehicles, would be low because of the limited number of CBNG wells permitted.
- Species of concern that are not federally protected may be impacted by habitat loss, disturbance and habitat changes.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- Same as Alternative A but on a much larger scale. Twenty-five times as many wells, roads and utility corridors as under Alternative A. 6,680 miles of roads (2.9 to 8.8 miles per square mile). 20,697 miles of utility corridors (9 to 27.1 miles per square mile). Indirect impacts to wildlife on 884,000 to 4.7 million acres from:
- Loss of high value habitats such as prairie dog towns, sage-grouse leks and big game winter range.
- Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal.
- Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest or collisions with vehicles could occur, but impact would be less than Alternatives C or D with the restricting of utilities and roadways to the same corridor.
- All species of concern that are not federally protected may be impacted by habitat loss, disturbance and habitat changes.

Alternative C
Emphasize CBNG Development

- Similar impacts as Alternative B. Indirect impacts to wildlife would occur on 884,000 to 4.7 million acres from:
  - Discharge of untreated CBNG water into drainages would impact riparian and wetland habitat and associated species because of poor water quality and erosion.
  - Increased livestock grazing within two miles of CBNG discharges that occur in areas without summer water
  - Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest or collisions with vehicles, are greater under this alternative than any other because of the increased number of CBNG well permits.
  - Potential indirect impacts to T&E species from changes in riparian habitat. Bald Eagles and Interior Least Terns may also be affected if SAR changes affect forage fish.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- Impacts would be similar to Alternative B:
  - Discharged treated CBNG water would erode riparian and wetland habitat
  - Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest or collisions with vehicles would occur at a level less than Alternative C.
  - Potential indirect impacts to T&E species from hydrology changes caused by increased water levels may impact nesting Interior Least Terns. If hydrology changes from surface water runoff, cause riparian vegetation changes, other T&E species may be impacted as well, such as nesting Bald Eagles.
  - Species of concern that are not federally protected may be impacted by habitat loss, disturbance and habitat changes.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- Direct and indirect impacts would occur similar to Alternative B.
- Indirect impacts to wildlife would occur on 884,000 to 4.7 million acres depending on development spacing.
- Loss of intermittent wildlife habitat associated with streams because of groundwater withdrawal.
  - This alternative would not directly impact any T&E listed wildlife species.
  - Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest or collisions with vehicles could occur.
  - Species of concern not federally protected may be impacted by habitat loss, disturbance and habitat changes. These impacts may be less than under Alternatives B, C, & D through the implementation of the Wildlife Monitoring and Protection Plan. However, this alternative would include more holding ponds than any other development alternative and consequently, Alternative E would include a greater risk of West Nile virus infection to sage-grouse than any other development alternative. The risk would be minimized by implementing BMPs to control mosquito populations associated with holding ponds.
- More water would be available for wildlife and livestock as a result of CBNG production.
- An adaptive management strategy, included in the Wildlife Monitoring and Protection Plan, would help to minimize impacts to wildlife and habitat by:
  - Utilizing and evaluating new information to change

or form additional conditions of approvals.

– Monitoring habitat use/wildlife populations and reclamation activities that will allow mitigation measures and stipulations to be evaluated for effectiveness.

Alternative F
Phased Development Multiple Screens (High Range)

- Direct impacts are expected to be less than Alternatives B, C, D and E during the time when fewer wells are being drilled and fewer production facilities are installed.
- If habitat thresholds are met and well development is restricted, acreages of indirect impacts would be the less than Alternatives B, C, D and E.
- Indirect effects from new roads and new utility lines would be similar to Alternatives B and D, but less than Alternatives C and E while federal restrictions are applied.
- Loss of wildlife habitat associated with streams as a result of groundwater withdrawal.
- Thresholds for important sagebrush-steppe habitat impacts could result in slightly less impacts to wildlife than under Alternative E particularly sage-grouse and other sagebrush and grassland associated species
- Species may be impacted by habitat loss, disturbance and habitat changes. These impacts may be less than under the other development alternatives due to established habitat and well development thresholds and the implementation of the Wildlife Monitoring and Protection Plan. However, this alternative would include a greater risk of West Nile virus infection to sage-grouse than Alternatives B, C, D, or G.
- Potential impacts to sage-grouse and other sagebrush dependant species would be lessened due to conditions placed on development within crucial sage-grouse habitat areas.
- Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest, or collisions with vehicles are present, but less so than other development alternatives due to implementation of the Wildlife Monitoring and Protection Plan and established habitat and well development thresholds.
- An adaptive management strategy, as described under Alternative E above, would help to minimize impacts to wildlife and habitats.

Alternative G
Phased Development Multiple Screens (Low Range)

- Acres of direct and indirect impacts would be less than all other development alternatives.
- Indirect effects from new roads and new utility lines would less than all other development alternatives.
- Species may be impacted by habitat loss, disturbance and habitat changes. These impacts would be less than under the other development alternatives due the less amount of well, road and utility line development, as well as the implementation of the Wildlife Monitoring and Protection Plan. However, the risk of West Nile Virus to sage-grouse would be greater than Alternatives B, C and D, but less than Alternatives E or F.
- Potential indirect impacts to T&E species, such as human disturbance, increased illegal harvest, or collisions with vehicles, but less so than Alternatives B, C, D, E and F.
- An adaptive management strategy, as described under Alternative E above, would help to minimize impacts to wildlife and habitats.

Alternative H
Preferred Alternative - Multiple Screens

- There would be less potential for displacement of sage-grouse as Alternative H calls for maintaining sage-grouse populations consistent with control populations.
- Rate of development managed by the number of Federal APDs that would be approved per year to protect other resources.
- Geographic development of CBNG resources managed by the location of federal APDs approved to protect other resources.
- Amount of acres disturbed in crucial habitat areas managed by limits associated with federal wells
- Protection of tribal resources from federal wells within 5 miles of reservation boundaries
- BLM would require wildlife monitoring and use adaptive management techniques to protect wildlife

Less potential for the displacement of sage-grouse from crucial habitat areas due protecting source populations

Assumptions

CBNG exploration, production and abandonment on BLM-administered minerals is subject to the stipulations summarized in Table 4-67. These stipulations are recommended for, but do not necessarily apply to, CBNG-related activities on non-BLM-administered surfaces. Therefore, the stipulations would avoid some of the potential impacts on BLM-administered surfaces, but may or may not avoid impacts on non-BLM-administered surfaces. The success of these stipulations in avoiding impacts would require collection of site-specific information regarding the resources to be protected in relation to exploration, production and abandonment plans, followed by strict adherence to the terms of the stipulations. For the purposes of this analysis it is assumed that the stipulations offer some protection to wildlife species on BLM-administered lands. It is further assumed that these stipulations which are very species specific, offer some degree of protection to many other species that use the same habitat during the same time period.

The assumption is made that existing stipulations would provide some protection to sage-grouse habitat including lek areas, nesting habitat and winter range. It is recognized that these actions would not completely protect this species. Mitigation measures within the Wildlife Monitoring and Protection Plan (WMPP) located in the Wildlife Appendix will provide additional protective measures. Lease stipulations and terms and conditions would provide protection to

TABLE 4-67

EXISTING WILDLIFE-RELATED LEASE STIPULATIONS COVERING CBNG EXPLORATION AND DEVELOPMENT ON BLM-ADMINISTERED SURFACES

Resource	No Surface Use	No Surface Occupancy	No Surface Use or Occupancy
Riparian areas		X	
100-year floodplains of major rivers, streams and water bodies		X	
Water bodies and streams		X	
Crucial big game and sage-grouse winter range*	December 1 - March 31		
Elk calving areas*	April 1 - June 15		
Powder River Breaks bighorn sheep range		Within designated bighorn sheep range	
Grouse leks			Within ¼ mile of lek
Grouse nesting zones*	Within 2 miles of leks from March 1 - June 15		
Raptor nests*	Within ½ mile from March 1 to August 1, within ½ mile of raptor nest sites which have been active within the past 2 years.		Within ¼ mile of nest
Bald eagle nests and nesting habitat	Within ½ mile from March to August 1, within ½ mile of raptor nest sites which have been active within the past 2 years.		Within ½ mile of nests active in the last 7 years and within riparian area nesting habitat
Peregrine falcon			Within 1 mile of nests
Ferruginous hawk			Within ½ mile of nests active within 2 years
Piping plover			Within ¼ mile of wetlands identified as piping plover habitat
Interior least tern			Within ¼ mile of wetlands identified as Interior Least Tern habitat
Prairie dog colonies > 80 acres	Controlled surface use		

Note: These stipulations are attached to leases and can affect exploration and construction

*Stipulation does not apply to operation and maintenance of production facilities.

Please refer to Table MIN-5, Minerals Appendix, for a listing of resource mitigation.

raptors and the mountain plover. Protective measures contained in the WMPP (if fully implemented) would help reduce, but cannot avoid all impacts to all species of wildlife.

The DNRC TLMD may apply the following stipulations on a case-by-case basis to school trust lands leased for oil and gas exploration, development and production. The noxious weed stipulation is placed on all oil and gas leases issued by TLMD. Some of the stipulations indirectly relate to wildlife, while others are more specific. The dates on the timing restriction stipulation vary depending on the wildlife species to which it applies.

- **Notification:** Lessee shall notify and obtain approval from the DNRC's TLMD prior to constructing well pads, roads, power lines and related facilities that may require surface disturbance on the tract. Lessee shall comply with any mitigation measures stipulated in TLMDs approval.

- **Weeds:** The lessee shall be responsible for controlling any noxious weeds introduced by Lessee's activity and shall prevent or eradicate the spread of those noxious weeds onto land adjoining the lease premises.

- **Sensitive Areas:** This lease includes areas that may be environmentally sensitive. Therefore, if the lessee intends to conduct any activities on the lease premises, the lessee shall submit to TLMD one copy of an Operating Plan or Amendment to an existing Operating Plan, describing in detail the proposed activities. No activities shall occur on the tract until the Operating Plan or Amendments have been approved in writing by the Director of the Department. TLMD shall review the Operating Plan or Amendment and notify the lessee if the Plan or Amendment is approved or disapproved.

  After an opportunity for an informal hearing with the lessee, surface activity may be denied or restricted on all or portions of any tract if the Director determines in writing that the proposed surface activity would be detrimental to trust resources and therefore not in the best interests of the trust.

- **Wildlife Restrictions:**

  - To protect certain wildlife during periods important to their survival, surface occupancy or other activity shall be restricted from March 15 through July 15 of each year unless otherwise authorized in writing by the TLMD.

  - Potential wildlife conflicts have been identified for this tract. The TLMD would contact either the Montana Department of Fish, Wildlife and Parks office or the FWS office in the area for advice on alleviating any possible conflicts caused by lessee's proposed activities. Additional mitigation measures may be required.

  - Wildlife species of concern have been identified on or near this tract. A survey in areas of proposed activity may be required prior to disturbance. Identified species would be avoided, unless otherwise authorized by the TLMD. Additional mitigation measures may also be required.

- **Miscellaneous Restrictions:**

  - Plant species of concern have been identified on or near this tract. A vegetation survey in areas of proposed activity would be required prior to disturbance. Identified rare plant species would be avoided, unless otherwise authorized by the TLMD.

  - A critical weed problem exists on this tract. Additional mitigation measures would be required to prevent further spread of noxious weeds. The department may require such measures as power washing of vehicles, car pooling, timing restrictions for seismic, etc. to facilitate this prevention.

  - This tract contains biological weed-control sites, which must be avoided unless otherwise authorized by TLMD.

- **Other:**

  - Any activity within 1/8 mile of the river or lake/reservoir on or adjacent to this tract must be approved in writing by the TLMD prior to commencement. No surface occupancy would be allowed within the bed of the river, abandoned channels, the bed of the lake/reservoir, or on islands and accretions associated with the river or lake/reservoir.

  - No activity shall be allowed within 100 feet of any perennial or seasonal stream, pond, lake, prairie pothole, wetland, spring, reservoir, well, aqueduct, irrigation ditch, canal, or related facilities without prior approval of the TLMD.

  - Wooded areas on this tract would be avoided unless otherwise authorized by the TLMD.

In addition to these stipulations, motorized vehicle use for recreationists on state trust lands is restricted by current policy to federal, state and dedicated county roads or other roads regularly maintained by the county, or to other roads that have been designated open by DNRC. Off road use is prohibited. Increased posting efforts, i.e., Walk-In Only signs, may be implemented by the TLMD to reduce unauthorized use of two-track trails and roads by recreationists to alleviate increased pressure on wildlife. Exploration for and development of CBNG wells would cause a wide range of both direct and indirect impacts on wildlife. The extent and duration of effects on wildlife would depend on the animal species, the type and quantity of vegetation removed, the nature and period of disturbance and the success of stipulations in reducing or avoiding some impacts. The impacts described below assume that the site-specific natural resource information and the stipulations discussed above are successfully used to avoid certain impacts on BLM-administered and state lands.

As previously described, the No Action Alternative includes exploration for and development of a relatively small number of CBNG wells (compared to the other alternatives) and the associated roads, pads, power lines, pipelines, utility corridors, facilities and human activities and presence. Many of the direct and indirect impacts of CBNG development on wildlife described for Alternative A would occur regardless of the number of CBNG wells developed, with the extent of impacts roughly proportional to the number of wells. These direct and indirect impacts are discussed below under the No Action Alternative and referenced as appropriate in the discussion of the impacts of Alternatives B through H. Additional ecosystem-level impacts associated with the substantially larger number of CBNG wells that would be developed under Alternatives B through H are discussed under those alternatives.

For Alternatives A thru E, sage-grouse habitat would be managed in accordance with the current BLM policy for management of BLM sensitive species and as outlined in the FSEIS and WMPP; specifically, BLM sensitive species management cannot impact these species in a way that may cause further declines in the species population status. For Alternatives F and G, a wildlife screen is included for the protection of wildlife habitat. For Alternatives F and G, additional sage-grouse population management prescriptions could also be implemented with the goal of maintaining the current sage-grouse populations (see WMPP for specifics). For Alternative H, BLM would apply broad or universal BMPs within crucial sage-grouse habitat, coupled with monitoring to determine the success of these BMPs. Development within sage grouse habitat would only be allowed if the operator can show the development will not result in the decrease in sage-grouse populations, when compared to control leks. Further restrictions could be implemented if monitoring shows the management is not effective in maintaining sage-grouse in the development areas.

Impacts From Management Common to All Alternatives

The responses of wildlife to facilities and activities associated with oil and gas development are complex but well documented (Wisdom et al. 2000; USDI and USDA 2001; Trombulak and Frissell 2000). Tolerance of various types of environmental disturbances varies among species and among individuals of the same species. The potential for impact is related to the timing and nature of the disturbance, severity of winter, habitats and species present, physiological status of the animal, hunting pressure and other disturbance factors and predictability of the disturbance. The scale of oil and gas development, number and length of associated roads and other facilities and implementation of measures to avoid or reduce impacts also influence the probability and severity of impacts on wildlife.

Direct and indirect impacts of road construction and use on wildlife and wildlife habitat have been well documented for oil and gas projects and other natural resource developments. Impacts include a wide range of biological effects, such as habitat loss, displacement because of noise and human disturbance and stress. The types of impacts expected to result from oil and gas development would be similar to those described in detail under Alternative A for CBNG development. The extent of the impacts would vary depending on the level of development.

A detailed discussion of impacts and mitigation measures for wildlife is included in the remainder of this section and in the Wildlife Appendix. This discussion addresses the direct and indirect quantitative and qualitative impacts that would likely result from CBNG development in the Powder River and Billings RMP areas. The impacts from conventional oil and gas development would be similar to those anticipated for CBNG but at a scale associated with conventional oil and gas development as identified in the Miles City District's *Oil and Gas Final EIS* (BLM 1992).

Construction and operation of the proposed TRR would directly and indirectly affect wildlife in the project area, primarily big-game species (deer and pronghorn) and birds (upland, waterfowl, songbirds

and raptors). Direct impacts would include the loss of some wildlife habitat within the ROW and displacement of some wildlife within or near the ROW. Other wildlife impacts could include elimination of relatively nonmobile species; loss of animals due to collision with trains or maintenance vehicles; creation of a barrier to some species; potential damage or elimination of habitat by dust, herbicides, fuel or other hazardous material spills and fire; and disturbances to nearby animals. Indirect impacts would include general demands on the environment associated with increased human population, such as increased county road wildlife-vehicle collisions, displacement of wildlife by recreationists and increased illegal harvest and hunting (STB 2004). Construction and operation of the TRR would be in accordance with all state and federal rules and regulations and would use mitigation measures and BMPs to minimize impacts to wildlife.

Impacts From Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

CBNG exploration and production includes development of roads, pads, power lines, pipelines, utility corridors and facilities as well as human activities and regular human presence. Much of this activity would occur in the relatively undisturbed native short grass prairie of eastern Montana, resulting in both direct and indirect impacts on wildlife. Those impacts would be localized around CBNG exploration and production sites and proportional to the level of activity at a particular location. The following discussion documents the types of impacts that would be expected from CBNG-related actions. These impacts would occur on BLM, state and private lands.

While the types of impacts described below would occur under all of the alternatives, the extent of the impact would be roughly proportional to the extent of CBNG development under each alternative. The number of CBNG exploratory and development wells under the No Action Alternative is 1/20th the number that would be developed under the other alternatives. Therefore, the extent to which these impacts would occur under the No Action Alternative is relatively minor compared to the other alternatives.

With a few exceptions, the same types of impacts to wildlife would occur under all of the alternatives. Therefore, they are described under Alternative A below. Differences in the type or extent of impacts between alternatives are noted for Alternatives B through H.

Direct habitat loss and direct and indirect impacts because of habitat disruption and wildlife disturbance caused by roads, pipelines and utility corridors would cause the bulk of the impacts on wildlife. Numerous studies have documented the direct and indirect impacts on wildlife from road development, human presence in formerly remote areas and facilities construction (Trombulak and Frissell 2000, Wisdom et al. 2000). The nature of these impacts and how they relate to exploration, development and maintenance of CBNG wells is discussed in the text that follows. In most instances, the impacts would occur during all CBNG phases. Exceptions are noted as appropriate.

Direct impacts would include loss of habitat to accommodate project features. They would persist for the duration of CBNG activities and, in the case of loss of habitat value, beyond that time. Some degree of habitat loss and degradation would continue following CBNG abandonment because of ecological differences between reclaimed sites and native vegetation.

The amount and types of habitat that would be directly lost from exploration and development are described in the *Vegetation* section. The species that would be affected by direct habitat loss would depend on the location of CBNG exploration and development and the types of habitat affected. Based on the average area expected to be disturbed by exploration and development of each CBNG well, about 675 acres would be impacted during exploration, a total of 1,500 acres would be impacted in the short term by well development (including the 675 exploration acres) and 500 acres would be subject to long term impacts during operations under Alternative A. Direct impacts on wildlife would also include mortality as relatively less mobile small mammals, reptiles and amphibians are killed during road and other site construction. Smaller mammals, reptiles and amphibians are most likely to be directly killed by vehicles and are vulnerable when crossing roadways (USDI and USDA 2001). Amphibians are especially vulnerable to being killed on all types of roads because their life histories often involve migration between wetland and upland habitats and individuals are often inconspicuous and slow-moving. Inexperienced juveniles of many raptor species experience high rates of mortality from collisions with vehicles (Trombulak and Frissell 2000). Grouse are particularly susceptible to collision mortality during the spring because they often fly to and from leks near the ground. Also, higher CBNG-related traffic volumes on existing paved roads would result in higher mortality rates for reptiles that seek out roads for thermal cooling and heating (Vestjens 1973).

Direct mortality from vehicle collisions would be expected to increase for all wildlife along both new and existing roads used for CBNG exploration and well construction and maintenance (Groot et al. 1996). Collision mortality would be most injurious to small and declining populations with limited distribution. Direct impacts from collision and crushing would continue for the duration of the project along roads until they are successfully closed and reclaimed. Some additional mortality would continue indefinitely because some new CBNG roads would not be closed and reclaimed.

Additional direct impacts would occur on private lands because state and federal lease stipulations are recommended but not required. State requirements would lessen direct impacts on state lands compared to private lands. These impacts include greater potential loss of riparian vegetation and other floodplain habitats valuable for wildlife, abandonment of raptor nests because of direct habitat loss and disturbance and habitat loss for a wide range of species that occupy prairie dog towns.

Table 4-68 indicates the relative level of vulnerability of different representative types of wildlife to direct and indirect impacts. Most indirect impacts on wildlife would occur during all CBNG phases on BLM, state and private lands. The duration of effects would correspond with the duration of each phase and the intensity of activity during that phase. The relative magnitude of impacts would be directly related to the nature and extent of activities associated with each phase of CBNG development. Some indirect effects would persist beyond abandonment because continued human use of some CBNG and user-created roads that are not closed and reclaimed (USDI and USDA 2001).

While roads do not affect all species and ecosystems equally, the overall presence of roads correlates highly with changes in species composition, population size and hydrologic and geomorphic processes that shape aquatic and riparian systems. All types of roads affect terrestrial species in several ways:
(1) increased mortality from road construction,
(2) increased mortality from collisions with vehicles,
(3) modification of animal behavior, (4) alteration of the physical environment, (5) alteration of the chemical environment, (6) spread of exotic species and (7) increased alteration and use of habitats by humans (Trombulak and Frissell 2000).

CBNG-developed roads and two-track trails would provide access into previously roadless areas and would result in additional user-created roads and trails branching off from CBNG roads (USDI and USDA 2001). Access to most CBNG roads on private lands would be restricted by the surface owner. Public access would be restricted on most CBNG roads on BLM-administered surfaces through the use of fences and gates. This is expected to be successful in limiting the majority of public access. However, the open rolling nature of the terrain in the project area combined with the proliferation of four-wheel-drive trucks and all-terrain vehicles would allow the creation of user-created roads (USDI and USDA 2001). This would cause additional road-related direct and indirect impacts over large open areas because of the great sight distances in central and southeastern Montana.

Some CBNG roads would continue to be used by the public throughout the entire production phase because road closures are difficult to implement and enforce in flat to rolling short grass prairie habitat. This continued use would hamper reclamation efforts on some CBNG roads while others would remain open to the public by choice. Some portion of CBNG roads, as well as user-created roads, would become permanent, with all of the associated direct and indirect impacts on wildlife and habitat.

Human use of all types of roads is a source of stress for many species (Knick et al. 2003). Roads also may affect an animal's reproductive success (Gutzwiller 1991). Golden eagles prefer to nest away from human disturbances, including roads and have reduced nesting success in nests located closer to roads than in nests farther from roads (Fernandez 2001). Chronic physiological stress on wildlife can result in increased sickness, a decrease in individual productivity (Knight and Cole 1991 Anderson and Keith 1980, Yarmoloy et al. 1988) and eventually result in population declines (Anderson and Keith 1980).

The increased access provided by both CBNG and user-created trails and roads over the span of all CBNG phases and beyond would result in additional legal and illegal harvest of game animals (Cole et al. 1997), recreation shooting of animals such as prairie dogs or other species (Ingles 1965) and chasing and harassing of animals (Posewitz 1999, USDI and USDA 2001). Human-caused fires are likely to increase in areas not regularly accessed by the general public before CBNG and user-created roads were present.

Indirect impacts of road development and use as would occur during exploration, development and production on wildlife and wildlife habitat have been well documented for a variety of natural resource extraction and development projects (Trombulak and Frissell 2000, USDI and USDA 2000, Wisdom et al. 2000, Braun et al. no date listed). Indirect impacts of CBNG exploration and development on certain species of wildlife more sensitive to development and human disturbance would occur over much larger areas than the direct impacts.

The *Oil and Gas Development on the Southern UTE EIS* (BLM 2002c) suggested human presence associated with exploration and development of oil and gas wells disturbed wildlife at distances up to 1/2 mile and that operation and maintenance activities caused disturbance within 1/4 mile of wells and roads. The disturbance results both from the presence of people and from the noise associated with exploration and development. There are numerous studies documenting wildlife avoidance of roads and facilities and wildlife disturbance at distances of 1,650 feet (Madsen 1985), 6,600 feet (Van der Zande et al. 1980) and as far as two miles or more for sage-grouse (summarized in Connelly et al. 2000) and raptors (Fyfe and Olendorff 1976).

Impacts to mule deer habitat use, movements and populations are also a concern and have recently been examined by the Wyoming Cooperative Fish and Wildlife Research Unit in the Pinedale Anticline Project area in western Wyoming. This area has been identified as important winter range for mule deer and concerns exist regarding potential effects conventional gas field development may have on the deer population. Conclusions in the most recent progress report show there have been considerable interruptions in movement patterns and shifts in habitat areas used, resulting in population declines of approximately 48 percent in the wintering deer population. While no studies have been done in Montana evaluating CBNG impacts on mule deer movements and habitat use, it is reasonable to conclude mule deer in southern Montana, which do not exhibit migratory behavior, would be impacted by CBNG development. The types of impacts would be similar to those identified in the Wyoming study.

Elk avoidance of roads has been documented in many studies throughout the West (Lyon 1979 and 1983, Perry and Overly 1976, Rost and Bailey 1979, Ward et al. 1973). Human presence along roads displaces big game species such as elk as well as other species sensitive to human presence from otherwise useable habitat, especially during the day. Elk in Montana prefer spring feeding sites away from visible roads (Grover and Thompson 1986) and both elk and mule deer in Colorado prefer areas greater than 660 feet from roads during the winter (Rost and Bailey 1979). Lyon (1983) studied the effects of roads on elk distribution and habitat use. He reported that within blocks of available elk habitat, road densities of only two miles of primitive (undeveloped) road open to vehicle traffic per square mile resulted in elk displacement from over 50 percent of the available habitat in the areas with roads present. The avoidance was due to human disturbance and the resulting lack of security for the elk. This type of disturbance would be greatest in open country such as much of the Planning Area where line-of-sight distances are relatively long and escape cover is often limited.

Displacement from habitat because of roads, CBNG facilities and human disturbance may result in any of a number of individual and population level impacts on wildlife (Trombulak and Frissell 2000, Wisdom et al. 2000). These include stress, disruption of normal foraging and reproductive habits, abandonment of unique habitat features and increased energy expenditure. These factors contribute to reduced over-winter survival for individuals, poor condition entering the breeding season, reduced reproductive success and recruitment and eventually population declines (Trombulak and Frissell 2000, Wisdom et al. 2000). For example, many raptor species that nest along prominent landscape features such as cliffs in open country are easily disturbed during the nesting season, often resulting in nest abandonment (Fyfe and Olendorf 1976).

Overhead power lines constructed for production wells pose problems for a variety of wildlife species. Raptors sage-grouse and other species of birds occasionally collide with power lines, especially during periods of relatively poor visibility. Overhead power lines can benefit some raptors in open country by providing hunting perches. However, the additional perches also result in local population declines in prey species. For example, overhead power lines constructed in the vicinity of grouse leks and wintering areas can substantially increase predation rates on grouse. The risk of electrocution on federal and state lands is small because the BLM and State require power lines and poles be constructed to standards that would avoid raptor electrocution. Raptor and sage-grouse collisions with power lines have also been noted throughout the west including eastern Montana. Bevanger (1998) noted growing empirical evidence of the high risk of collision with powerlines for birds with heavy bodies and small wings that are characterized by rapid flight. These birds, including grouse, have a restricted ability to react swiftly to unexpected obstacles, such as powerlines (Bevanger 1998).

Another wildlife disturbance factor associated with CBNG exploration, development and operation is noise. The highest noise levels and greatest impacts would be expected during exploration and development, with lower noise levels during production operations. Noise levels would be similar on BLM and other lands. Animals react differently to noises, but noise is especially troublesome for birds.

Many neotropical birds that occur in the project area, such as western meadowlark, lark bunting, grasshopper sparrow, vesper sparrow, Brewer's sparrow, burrowing

TABLE 4- 68

VULNERABILITY OF WILDLIFE TO TYPES OF CBM IMPACTS, ALTERNATIVE A

(The relatively low impact probabilities in this table reflect the fact that the no action alternative includes a small number of CBM wells compared to the other alternatives)

	Species/Groups Affected [1]																			
	Big Game/Large Predators [2]		Sage and Sharp-tailed Grouse [2]		Raptors [2]		Waterfowl/ Shorebirds		Song Birds		Prairie Dog Colonies		Small Mammals		Reptiles and Amphibians		Bats		Small Predators	
Type of Impact	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops	Exploration	Devel/Ops
Direct Impacts																				
Habitat loss	1	2	1	2	1	2	0	0	1	2	2	3	1	2	1	1	2	2	1	2
Vehicle collision / crushing	1	2	2	3	1	1	0	0	1	1	1	2	3	3	3	3	0	0	0	1
Greater public access (increased poaching, fire, and legal hunting)	1	3	1	2	1	2	1	1	0	0	1	2	0	1	0	1	0	1	2	3
Indirect Impacts																				
Disturbance and displacement from CBM-associated human presence and activities.	3	3	3	3	3	3	2	2	2	2	1	1	2	2	1	1	0	1	1	2
Noise disturbance/displacement/stress	2	2	3	3	1	1	1	1	3	3	0	0	1	1	1	1	1	1	1	2
Above-ground power lines	0	0	0	3	0	3	0	2	0	2	1	2	0	1	0	0	0	0	0	0
Noxious weed habitat degradation	0	2	0	2	0	2	0	0	0	2	0	1	1	2	0	1	0	0	0	1
Presence of new CBM and user-created roads	0	3	0	3	0	2	0	1	0	2	0	2	0	2	0	2	0	0	1	2
Habitat fragmentation	0	1	0	2	0	1	0	0	0	1	0	1	0	1	0	1	0	0	1	2
Sediment runoff from roads and excess CBM water/water quality degradation	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2	1	2	0	0
Altered surface hydrology (springs and small stream flows reduced)	0	1	0	2	0	0	0	1	0	1	0	0	0	1	0	2	0	1	0	1
Increased livestock use of range due to CBM water sources	0	2	0	3	0	2	0	2	0	3	0	0	0	2	0	2	0	0	0	1

Notes:

Vulnerability of wildlife to categories of impacts are based on the nature of impact, species involved, and relative number of wells.

0 = little or no vulnerability

1 = low vulnerability

2 = moderate vulnerability

3 = high vulnerability

[1] Relative vulnerability assumes collection of site-specific data needed to follow stipulations during exploration and development on BLM lands, and strict adherence to stipulations.

[2] Vulnerability would be slightly lower for certain habitat components on BLM lands during exploration, than on non-BLM lands.

owl and short-eared owl, may be affected by energy development. There is little research identifying impacts of energy development to these sagebrush/grassland migratory species. However, there is research documenting negative impacts of noise to many species. Most species are vulnerable to activities that reduce or fragment sagebrush/grassland habitats.

Direct impacts include destruction of nests during construction of roads, pipelines, power lines (buried and overhead), well pads and retention ponds; and displacement of birds from the construction area. Increased mortality of migratory birds would be likely from increased road traffic associated with operation and maintenance of these facilities.

Indirect impacts would include physical disturbances and physiological stresses on migratory birds from increased human activity in the area, as well as increased habitat fragmentation leading to reduced nesting for species that require large habitat areas.

CBNG activities that reduce or fragment sagebrush/grassland habitat would impact nesting migratory birds in the project area. Although average territory size for grasshopper sparrows, for example, is small (less than 2 hectares), they are area-sensitive and prefer large grassland areas over small areas (Dechant et al. 1998).

When construction is completed and human presence has decreased, some displaced migratory birds would return to suitable habitats.

Male neotropical migrant birds that breed in short grass prairie, sagebrush and riparian communities use songs to establish and defend breeding territories and attract females. Noise interferes with this ability, with the level of interference related to the volume and frequency of the noise (Luckenbach 1975, Luckenbach 1978, Memphis State University 1971, Weinstein 1978). Other noise-related problems for birds around CBNG exploration and production wells and compressors include interference with the ability to recognize warning calls and calls by juveniles, both of which can result in higher predation rates. The area of disturbance would vary by species and CBNG activity. Producing wells would be relatively quiet once production is underway. Compressors would be limited to 50 decibels at a distance of 1/4 mile.

Stipulations prohibit surface occupancy in riparian areas and on floodplains of major rivers. However, they do not prohibit crossing of streams or construction of roads through riparian areas. Roads constructed through riparian areas and other forest and shrub stands for CBNG development and operation create edge effects and alter the physical environment (Trombulak and Frissell 2000). Roads create drier conditions in the vicinity of the road, thereby altering habitat for many species. In grassland and shrubland habitats, trails and roads create edge habitat for predators and reduce patch size of remaining habitat for area-sensitive species (USDI and USDA 2001, Ingelfinger 2001). Swihart and Slade (1984) found prairie voles (*Microtus ochrogaster*), which occur in the Planning Area, were reluctant to cross tire tracks running through an open field. Reluctance to cross narrow gravel roads has also been observed in white-footed mice (*Peromyscus leucopus*), which also occur in the Planning Area and many other rodent species (Mader 1984, Merriam et al. 1989, Oxley et al. 1974). Consequently, roads can function as barriers to population dispersal and movement for small mammals that occur in the Planning Area.

Many amphibians annual life cycles require migration between habitats with different ecological properties. These species' populations depend on dispersal connections and landscape links (Gibbs 1998). Simple linear structures such as roads of all types can act as physical and psychological barriers for amphibian movement (Mader 1984, Gibbs 1998). Furthermore, motorized off-highway travel may disrupt reptile and amphibian habitat to the point where it becomes unusable (Busack and Bury 1974). Pronghorns and mountain lions have also demonstrated reluctance to crossing roads (Bruns 1977, Van Dyke et al. 1986).

Noxious weeds and exotic plants rapidly colonize disturbed sites, prevent native species from being re-established following ground disturbance, spread into undisturbed areas reducing habitat value on additional lands and provide very poor quality wildlife habitat or forage. Mitigation measures discussed under vegetation are intended to avoid, reduce and control new infestations of noxious weeds through a variety of actions. Consistent and successful application of these mitigation measures would reduce potential habitat degradation. However, use of chemicals to control noxious weeds usually also kills non-target beneficial native plants, contributing to habitat loss.

Roads are sources of fine sediment that can enter wetlands and intermittent and perennial drainages, especially following thunderstorms. Effects include increased turbidity (Reid and Dunne 1984), smothering wetland vegetation and degradation of habitat for amphibians and other aquatic life (Newcombe and Jensen 1996).

There are no apparent differences between indirect impacts on wildlife on BLM-administered and state lands. Impacts on private lands may be more substantial because stipulations and mitigation measures are not mandated on private lands.

Species of Concern

Species of concern include federally listed T&E and candidate species; Montana species of concern; BLM species of concern, and MNHP species of concern. For the State of Montana species of concern, this document addresses only those listed as category S1, which are species of extreme rarity or species for which some factor of its biology makes it especially vulnerable to extinction. Chapter 3 of the EIS describes and lists all special-status species.

As discussed in the *Species of Concern* section of Chapter 3 in this EIS, there are 9 federally listed threatened, endangered and proposed species; and 3 federal candidate species. In accordance with the ESA, listed wildlife must be protected from possible impact by oil and gas and CBNG development on all lands. ESA protected plants are not protected on private lands. Additionally, there are many species classified as "species of special concern" by the Montana BLM and Montana Natural Heritage program (MNHP). By policy, BLM management cannot impact these species in a way that may cause further declines in the species' population status. These include 68 plant, 16 mammal, 9 herptile and 22 bird species and are listed by the state and BLM. This section will address federally listed wildlife species protected under the ESA. General recommendations for other species of concern wildlife species can be found within the general Wildlife impact sections. Federally listed species are discussed individually because of the need for species-specific mitigation measures to avoid extensive impacts. Conclusions are summarized after all of the species are discussed.

For sensitive species, displacement from important habitat features is often effectively equal to loss of habitat for the individuals that occupied that habitat. Wildlife cannot generally just move to unoccupied habitat in response to disturbance and survive there, as other suitable habitat is occupied by other individuals of the same species or by similar species using the available resources.

Federally Listed Species

Mountain Plover

Mountain plover are most susceptible to disturbance during the nesting season, which occurs between mid-April and early July. Construction activity and operations and maintenance could disturb the nesting/courting birds during this period. Noise and the presence of humans and equipment would be the main causes of disturbance. The absence of stipulations to protect mountain plover nesting areas (prairie dog towns smaller than 80 acres) would result in impacts on this species if exploration or development occurs in or near occupied nesting habitat. Prairie dog towns often are located on flat, topographically low areas.

Interior Least Tern

As with mountain plover, this species is susceptible to disturbance during the nesting period.

Gray Wolf

Roads and the presence of humans would increase the threat from shooting, either on purpose or accidental (when mistaken for a coyote). The potential density of roads in occupied wolf areas could force wolves from occupied areas and could increase stress on wolves and result in the loss of some individuals.

Canada Lynx

Canada lynx would be expected mainly in western and south-central Montana, where high-elevation, dense, old-growth forests are most likely to be found. Although possible, exploration and development of CBNG are not expected to occur in these habitats. Therefore, there would be no impacts to Canada lynx.

Black-Footed Ferret

Black-footed ferrets are exclusively found associated with their main prey species: prairie dogs. Prairie dogs are found throughout the project area. Any activity affecting prairie dog colonies has the potential to impact the ferret. Prairie dog colonies are frequently located on level to slightly sloping ground. Two BLM leasing stipulations address black-footed ferret concerns. The first states that exploration in prairie dog colonies within potential black-footed ferret reintroduction areas comply with the Draft Guidelines for Oil and Gas Activities in Prairie Dog Ecosystems Managed for Black-footed Ferret Recovery (FWS 1988, BLM 1992). If these guidelines are accepted, they specify that conditions of approval depend on the type and duration of the proposed activity, proximity to occupied ferret habitat and other site-specific conditions. Exceptions or waivers of this stipulation may be granted if the Montana Black-Footed Ferret Coordination Committee determines that the proposed activity would have no disagreeable impacts on ferret reintroduction or recovery. The status of the Fort Belknap population allows them to be treated as a proposed species, which may require a conference with FWS if impacts are expected in the vicinity of the reservation.

The second stipulation requires that all prairie dog colonies or complexes greater than 80 acres in size be surveyed for black-footed ferret absence or presence prior to ground disturbance. Prairie dog complexes

may consist of several smaller colonies located near one another. The results of the survey determine if restrictions or denial of use are appropriate for the site. Permits issued by MBOGC do not have the same stated requirements for protection of prairie dog towns of certain sizes; however, the ESAs protection of listed wildlife does apply to state and private land. Operators are prohibited from causing harm to the ferret. As appropriate, state leases would include a survey stipulation or contact MFWP stipulation for species of concern.

Implementation of stipulations in potential and occupied habitat would avoid impacts to the ferret on BLM-administered surface.

Grizzly Bear

Threats to grizzly bears mainly result from human-bear interactions, which occasionally end in the death of the grizzly bear. If exploration moves into sparsely settled areas or previously roadless areas within grizzly bear range, the possibility of bear-human interaction increases.

Federal Candidate Species

One candidate species may potentially be found in the project area: the black-tailed prairie dog. Although not subject to the substantive or procedural provisions of the ESA, FWS encourages no action be taken that could impact candidate species and contribute to the need to list the species. The state also has a policy that the state should take no action that could contribute to these species being listed. The USFWS issued a "not warranted" finding for black-tailed prairie dogs in 2004.

Black-Tailed Prairie Dog

As discussed under black-footed ferret above, BLM has stipulations governing activities that could impact black-tailed prairie dog towns larger than 80 acres if ferrets are found to be present. However, these protections do not apply if the ferret is not present. The MFWP through a working group composed of state, federal and private individuals is developing a Prairie Dog Conservation Plan to address how to avoid continuing impacts, which are resulting in population declines. There are no special protective measures being implemented by the state or BLM at this time, although an evaluation including associated impacts to other listed species, in order to identify measures to avoid impacts is required. Construction of CBNG exploration and production wells on all land ownerships is expected to impact black-tailed prairie dog towns.

BLM, USFS and Montana Species of Concern

Under all alternatives, the variety of life forms and the large number of species of concern, the lack of specificity of project locations and the wide variation in habitat used by these species preclude the ability to identify specific impacts to each individual species of concern. Exploration and development of CBNG wells would result in a variety of direct and indirect impacts to species of concern. Specific impacts would depend on the species, the amount and type of habitat removed and the nature and period of disturbance. Leasing stipulations as discussed above and in the *Wildlife* section would offset or offer some protection to federally listed species. However, there are no stipulations for most species of concern.

Alternative A presents a discussion of impacts to all wildlife species, of which species of concern are a subset. That discussion is not repeated here and the reader should refer to the *Wildlife* section for an understanding of impacts to wildlife species of concern. Some of these species are particularly vulnerable because of their scarcity or narrow habitat niche.

Guidelines recently developed by Connelly et al. (2000) to manage sage-grouse populations and their habitat indicate that the stipulations stated above that are intended to avoid impacts on sage-grouse leks and nesting areas during exploration are not adequate to do so. Sage-grouse are extremely sensitive to human disturbance and habitat alteration and breeding populations have declined dramatically throughout much of their range (Connelly and Braun 1997) including south-central and southeastern Montana (Eustace 2001). MFWP has been monitoring certain sage-grouse leks in south-central Montana since the early 1980s. There has been an approximate 50 percent reduction in the number of these active leks since the monitoring began. Eustace attributes this decline to habitat loss and human disturbance and stated that he believes similar declines have occurred in other portions of Montana. Connelly et al. (2000) indicate energy-related facilities should be located at least two miles from sage-grouse leks. Connelly et al. further note sage-grouse populations display four types of migratory patterns: 1) distinct winter, breeding and summer areas; 2) distinct summer areas and integrated winter and breeding areas; 3) distinct winter areas and integrated breeding and summer areas; and 4) non-migratory populations. Furthermore, recent studies in eastern Idaho have found that sage-grouse wintering areas may vary considerably from year to year depending on snow accumulation (Kemner and Lowe 2002).

Avoiding impacts on sage-grouse requires protecting the integrity of all seasonal ranges. Average distances between leks and nests vary from 0.7 to 3.9 miles (Autenreith 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000) and movements between seasonal ranges may exceed 45 miles (Dalke et al. 1963, Connelly et al. 1988). Furthermore, sage-grouse have high fidelity to all seasonal ranges (Keister and Willis 1986, Fischer et al. 1993). Females return to the same area to nest each year (Fischer et al. 1993) and may nest within 660 feet of their previous year's nest (Gates 1983). However, other studies by Lyon 2000, Fischer et al. 1993 and Berry and Eng 1985 found average distances of 683 meters (2,240 feet), 740 meters (2,427 feet) and 552 meters (1,811 feet), respectively. Therefore, while important, protecting a 1/4-mile (1,320 feet) radius area around leks as specified in the stipulations, may be inadequate to avoid impacts on displaying and nesting birds. Furthermore, this stipulation does not provide sufficient protection of the breeding area or any wintering areas. This stipulation is not adequate to avoid all the impacts on sage-grouse from CBNG activities. Sage-grouse would be impacted by CBNG activities that occur within two miles of sage-grouse leks or within winter range.

Elevated noise levels might interfere with the ability of female sage-grouse to hear the booming of cock sage-grouse on the lek (USFWS 2005b). This might result in reduced lek attendance and reproductive success near CBNG locations, particularly where compressors that produce relatively loud noise levels are present. Researchers at University of California, Davis, are currently conducting a study on the effects of noise from CBNG development on sage-grouse in Wyoming (personal communication, G. Patricelli, 2005). Once complete, this study should provide additional information on the effects of noise on these birds.

Montana's Comprehensive Fish and Wildlife Conservation Strategy identifies the need to quantify impacts of energy development and determine ways to reduce, eliminate, or mitigate negative effects (MFWP, 2005d). Recent and ongoing research has focused on these issues.

In a recent research study conducted by Holloran and Anderson from the University of Wyoming, findings suggest natural gas development causes displacement of male sage-grouse from lek sites, ultimately contributing to localized sage-grouse extirpations, with negative, but less severe, influences on regional population levels (Holloran and Anderson 2004, Holloran 2005). Three levels of natural gas well development were evaluated in the study. Leks with fewer than 5 wells within the 5-km (3.2 miles) radius buffer were considered lightly impacted (control leks); leks with 5 to 15 wells within 5 km were moderately impacted; and leks with more than 15 wells within 5 km were heavily impacted. On heavily impacted leks, the maximum number of males declined by 51 percent from the year before impact. Furthermore, the maximum number of males on three heavily impacted leks situated centrally within the developing field declined 89 percent and two of the three leks were essentially inactive in 2004.

At a regional level, the number of strutting males counted on leks declined annually by an average of 13 percent (Holloran 2005). The study also indicated that female sage-grouse avoided nesting near the infrastructure of natural gas fields and natural gas related impacts negatively influenced female population growth. While this study was conducted in a conventional natural gas development field and not in CBNG areas, the types of impacts are expected to be similar.

Habitat fragmentation negatively impacts population persistence, both short and long term, with more fragmentation increasing habitat isolation and possibly changing population response to habitat modification (Patten et al. 2005). Fuhlendorf and others (2002) noted that large-scale patterns of land use and fragmentation have been associated with the decline of many imperiled wildlife populations. Their study of scale-dependent relationships between landscape structure and change, as well as long-term population trends for lesser prairie-chicken populations in the southern Great Plains, indicated that modifications in landscape structure over the past several decades resulted in stronger relationships with lesser prairie-chicken population dynamics than current landscape structure. Wisdom and others (2002) indicated the sage-grouse has been extirpated from five states and one province. Breeding populations have declined an average of 35 percent since 1985, due to a variety of detrimental land uses. These studies suggest that local populations have to be viewed at a landscape-level. Future conservation efforts should address effects of fragmentation on natural populations, including dispersal, colonization and extinction patterns (Fuhlendorf et al. 2002, Patten et al. 2005, Wisdom et al. 2002).

Beginning in 2003, Montana and Wyoming BLM have worked cooperatively with the University of Montana and other partners to determine the potential impacts of CBNG development in the Powder River Basin. The research being conducted has evolved into three phases that are expected to answer management questions about development impacts on sage-grouse and effectiveness of BLM mitigation measures. Final

reports are scheduled to be completed during January 2007 and January 2008.

In 2006, Dr. David E. Naugle, associated with the University of Montana and his researchers used satellite imagery on a landscape level to identify priority habitats for sage-grouse in the PRB. This information identified areas of high value sage-grouse habitats. This mapping used several components, including roughness, sagebrush coverage (height/abundance) and distance from conifers. In general, Dr. Naugle determined suitable long-term sage-grouse habitat must contain a minimum of 1,000 contiguous acres of sagebrush and must be at least 400 meters from visible conifers. Dr. Naugle's findings showed that sage-grouse avoided disturbance associated with CBNG development. Males on leks within areas of heavy CBNG development declined dramatically, while leks on the edge of development had increased numbers of males (Naugle, et al 2007). This increase is interpreted as an indication that those males previously using leks within areas of development were displaced to leks on the edge of disturbance. Leks outside of areas of disturbance followed the regional trend.

While the aforementioned studies provided compelling evidence of impacts, long-term studies in the Pinedale Anticline Project Area gave the most complete picture of cumulative impacts of energy development to sage-grouse populations. Lyon and Anderson (2003) showed that early in the development process, nest sites were farther from disturbed leks than from undisturbed leks, that nest initiation rate for females from disturbed leks was 24% lower than for birds breeding on undisturbed leks, and that 26% fewer females from disturbed leks initiated nests in consecutive years. As development of the Pinedale Anticline progressed, Holloran (2005) reported that adult female sage-grouse remained in traditional nesting areas regardless of increasing levels of development, but yearling females that had not yet imprinted on habitats inside the gas field avoided development by nesting farther from main haul roads. Kaiser (2006) and Holloran et al. (2007) later confirmed that yearling females avoided infrastructure when selecting nest sites and that yearling males that avoided leks inside of development were displaced to those nearer the periphery of the gas field. Recruitment of males to leks also declined as distance within the external limit of development increased, indicating the likelihood of lek loss near the center of development.

Perhaps the most important finding from studies in the Pinedale Anticline was that sage-grouse declines are at least partially explained by lower survival of female sage-grouse, and that impacts to survival resulted in a true population-level decline (Holloran 2005). The population-level decline observed in sage-grouse (Holloran 2005) is similar to that observed in Kansas in the Lesser Prairie-chicken (Tympanuchus pallidicinctus) (Hagan 2003), a federally threatened species that also avoided otherwise suitable sand-sagebrush (Artemisia filifolia) habitats proximal to oil and gas development (Pitman et al. 2005, Johnson et al. 2006). High site fidelity but low survival of adult sage-grouse combined with lek avoidance by younger birds (Kaiser 2006, Holloran et al. 2007) resulted in a time lag of 3-4 years between the onset of development activities and lek loss (Holloran 2005). The time lag observed by Holloran (2005) in the Pindeale Anticline matched that for leks that became inactive 3-4 years following intensive coal bed natural gas development in the Powder River Basin (Walker et al. 2007).

Overhead power lines pose several problems for sage-grouse. Sage-grouse occasionally collide with power lines, especially during periods of relatively poor visibility, such as flying to and from the leks. Overhead power lines provide hunting perches for raptors. Predation rates on sage-grouse increase dramatically when these lines are located in the vicinity of sage-grouse leks and wintering areas, resulting in population declines (Connelly et al. 2000, Milodrgovich 2001, Braun et al. no date listed).

As discussed in the *Hydrological Resources* section, surface water bodies would not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seams. In the unlikely event that there is a very localized connection between a spring-fed stream and groundwater withdrawals, effects on wildlife and habitat would include drying of springs and reduced flow and duration in intermittent and small perennial drainages. Sage-grouse could be severely impacted, as broods spend much of July and August in more mesic sites as sagebrush habitats desiccate (Gill 1965, Savage 1969, Connelly and Markham 1983, Fischer et al. 1998). Reduced availability of mesic sites would reduce sage-grouse brood survival and unfavorably affect populations (Connelly et al. 2000).

Bald Eagle

Bald eagles are sensitive to human presence. Based on the assumptions listed in the introduction to the *Wildlife* section, protection of nests and nesting habitat should prevent eagles from abandoning traditional nesting sites in the project area, but periodic or complete abandonment of non-nesting habitat may occur depending on the level of human use and noise. Above-ground transmission facilities could result in the death of some bald eagles because of electrocution.

However, the risk of electrocution on federal and state lands is small because the BLM and State require power lines and poles be constructed to standards that would avoid raptor electrocution (Table MIN-5). Power lines also pose strike hazards for bald eagles, especially near perennial rivers and water bodies that support fish and waterfowl. Removal of large trees in wintering areas, particularly at established roost sites, would also displace bald eagles by removing perch and roost sites.

Crow Reservation

Off reservation CBNG development would not indirectly impact wildlife on the Crow Reservation.

Northern Cheyenne Reservation

There would be fewer impacts to wildlife on the reservation resulting from off-reservation CBNG development, as the buffer between development and the reservation should mitigate most impacts..

Mitigation

Agency-applied mitigation measures for BLM and state lands related to natural resources are presented in Chapter 2 and Table MIN-5 of the Minerals Appendix. Agency-applied measures would be implemented as needed and enforced during all CBNG phases. Agency-applied mitigation measures are intended to compensate after-the-fact for some impacts not avoided through standard lease stipulations. Residual impacts are those that remain after implementation of mitigation measures.

BLM would include and enforce agency applied mitigation (described in Chapter 2 and the Minerals Appendix) through application of standard lease stipulations during the site-specific plan approval stage. Measures to further avoid or reduce impacts in addition to those included at the plan approval stage may be recommended. The state would apply additional mitigation measures on a case-by-case basis through the use of field rules.

Species of Concern Mitigation Measures

Bald Eagle

Before construction begins, a wildlife biologist would survey the construction zone in a 0.5-mile radius for bald eagles and bald eagle nests and identify any locations found. The use of no surface occupancy within 0.5 miles of known nests would reduce but not eliminate potential impacts to nesting, foraging and roosting bald eagles.

Mountain Plover

Surveys would be made within suitable mountain plover habitat within the roadway corridor and pad sites prior to exploration. FWS survey protocol for mountain plover would be followed. See the Wildlife Appendix Biological Assessment for Mountain Plover Survey Guidelines. This includes surveying from May 1 through June 15 for presence or absence on potential sites. Exploration and Construction would be avoided in these areas during this time period to assure that potential nesting mountain plovers are not prevented from setting up territories as a result of the presence of equipment and humans.

Interior Least Tern

The likelihood of encountering least terns within the SEIS area is remote. Should nest tern locations be identified, exploratory drilling and construction sites would be identified and appropriate surveys would be conducted for this species. Surface occupancy and use is prohibited within 1/4 mile of wetlands used by nesting interior least terns during exploration. This stipulation would minimize impacts to interior least tern. Occupied wetlands and water levels would be protected in all phases of drilling and construction and no discharge of produced water into occupied wetlands would be permitted.

Gray Wolf

Prior to construction in potential gray wolf habitat, surveys would include specific searches for this animal, occupied dens, or scat. The corridor would be surveyed in the spring, prior to construction, by a wildlife biologist for scat. If scat is found, the site would be surrounded by a buffer zone recommended through consultation with an FWS biologist. If wolves or other wolf indicators are found, FWS would be consulted and proper protocols followed.

Canada Lynx

Any construction areas or drilling pads located in high elevation, old growth forested areas considered potential Canada Lynx habitat, would be surveyed prior to construction for scat and individuals following established protocols. If found, the site would be avoided and surrounded by a buffer zone recommended by FWS biologists.

Black-Footed Ferret

Implementation of stipulations on occupied habitat would avoid impacts to the ferret on BLM-administered surface.

Grizzly Bear

Garbage and other human refuse would be removed from drilling and construction sites on a daily basis in potential bear habitat to avoid attracting bears. Surveys for scat and other sign of grizzly bears in remote, sparsely roaded areas would be conducted prior to construction. If found, protocol would be established after consultation with FWS biologists.

Black-Tailed Prairie Dog

Development of mitigation measures for the prairie dog depends upon the recommendations developed in the *Conservation Plan for Black-Tailed and White-Tailed Prairie Dogs in Montana (January 2002)*. This plan would address how to avoid continuing impacts.

Conclusions

If a state or private CBNG project triggers a federally related action, the FWS would need to be consulted for federally protected species, by the Federal agency.

Stipulations would avoid some impacts for some species. However, these stipulations would not be 100 percent effective for all species because of limits on available biological information, some stipulations do not apply to operations and the stipulations are not meant to eliminate all negative impacts. The potential for impacts is relatively low under Alternative A compared to the other alternatives because of the limited number of CBNG wells. Mitigation measures (Table MIN-5, Minerals Appendix) generally focus on vegetation reclamation and related efforts to reduce erosion and water pollution. Measures intended to reduce surface disturbance in sensitive habitats are to be implemented "to the extent practicable." Therefore, it is likely some sensitive habitats and species could be directly impacted by CBNG development under Alternative A. The intent of reclamation, as identified in Miles City Field Office (MCFO) policy is to re-establish a vegetative cover on disturbed areas rather than to restore native plant communities as they existed prior to disturbance. Plant species diversity would be lower on reclaimed sites than before disturbance, reducing overall wildlife habitat values. Existing mitigation measures would not effectively compensate for impacts on wildlife.

Some wildlife species and habitat may be disturbed or lost during construction. Individual animals may be lost through collisions with vehicles and indirect impacts as described previously for general wildlife. Indirect impacts also could result in displacement or abandonment of habitat or to increased legal and illegal hunting pressure. Species of concern on all lands do not have the same level of protection as ESA-protected species. Therefore, some direct and indirect impacts on individuals or even populations within metapopulations would be expected. This alternative would have the least impact on all species because of the limited number of wells and (500 long-term acres) associated disturbances.

If habitat degradation is minimized, mitigation measures applied and appropriate surveys conducted prior to construction, ensuring these species are not found within the project area and, if found, are buffered by suitable no construction zones and work restrictions, wildlife species would be affected but the impacts should be mitigatable.

There could be some displacement of bald eagles in non-nesting habitat. Black-tailed prairie dogs would be impacted by this alternative on or adjacent to prairie dog towns where CBNG development occurs.

Species not federally protected may be impacted by habitat changes caused by vegetation removal, changes in vegetation species composition, increased access because of more roads, increased noise levels and conflicts with CBNG infrastructure and increased human pressure. Changes in stream or spring hydrology and increased SAR and salinity values in water and soil could also have adverse impacts.

Cumulative Impacts

The cumulative impacts on wildlife resulting from the effects of Alternative A include the direct loss of wildlife habitat, habitat fragmentation and wildlife mortality from collisions. Noise and human presence would disturb wildlife species over large areas near developed well fields, causing local population declines for some species. This would be particularly problematic for sensitive species such as raptors, sage-grouse and other birds dependent on sagebrush habitats.

Impacts from Wyoming CBNG development on wildlife and wildlife habitat would be similar to those described under Alternative A, but at a far larger scale. More than 2.5 times as many CBNG wells may be developed in the Powder River basin of Wyoming than the 18,300 considered under Alternatives B, C, D and E in Montana. The magnitude of direct and indirect Wyoming CBNG impacts on wildlife and wildlife habitat would be about 2.5 times greater than described for Alternatives B, C and D (described in the following sections). CBNG development in Wyoming would cumulatively impact many species in Montana.

The increase in water volume at certain times has the potential to cover sandbars and other open areas. There would be potential cumulative impacts for bald eagles and interior least tern present in this river habitat, as

flow fluctuations and alterations in SAR values could affect the food chain these species rely on and because it may affect their nesting habitat.

Cumulative impacts of other activities, including the Tongue River Railroad, conventional oil and gas, active coal mines and fires are expected to result in the long term loss of an additional 41,070 acres. Types of indirect impacts on wildlife would be similar to those described above and would affect an area much larger than 37,000 acres. Some impacts on sensitive and protected species would be expected from development on this scale.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Generally, the same types of impacts on wildlife described for Alternative A would occur under Alternative B. However, Alternative B includes development or the drilling of 18,300 CBNG wells. This is about 20 times as many wells; miles of roads, pipelines and utility corridors and facilities and 20 times more human activity than for Alternative A. It is important to recognize the development would take place over a 20-year period and the initiation of well development (20 times) would not occur all at once. However, production at any given well is expected to continue for 20 years so there would be substantial overlap between wells developed early and those developed later in the 40-year time frame between development of the first wells and closure of the last ones. Because of this level of CBNG development, Alternative B would have widespread ecosystem-level types of impacts on wildlife and wildlife habitat as discussed at length for Alternative A.

Virtually every wildlife species that occurs within CBNG development areas would be impacted to some degree, with sensitive species suffering the greatest impacts because of their already precarious status. For example, wintering and nesting sage-grouse and nesting golden eagles would be expected to suffer large-scale impacts. It is likely that, at this scale of development, some species would become locally rare or vacate large areas. All of the wildlife groups listed in Table 4-68 would have a high probability of being impacted throughout the CBNG development area under Alternative B because of the scale of the development.

Table 4-66 in the Vegetation section notes the number of acres of direct impact (habitat loss) and the number of miles of roads, pipelines and utility corridors that would result from CBNG development under Alternatives B, C, D and E. Development under Alternative B would result in the direct short term loss of about 55,400 acres of wildlife habitat to well pads, roads (6,680 miles) and pipeline and utility corridors (20,679 miles). Long term impacts would persist on about 33,000 acres after reclamation of exploration disturbance. However, as noted for Alternative A, plant species diversity would be lower on reclaimed lands than before disturbance, resulting in reduced habitat value for many species and habitat fragmentation for some species. Additional vegetation would be disturbed by multiple exploration vehicles moving across the landscape searching for suitable locations to drill exploratory wells. Direct and indirect impacts on wildlife from this scale of development would be widespread.

The discussion of impacts for Alternative A indicated mule deer, elk, sage-grouse, raptors and other species are particularly sensitive to human disturbance associated with CBNG development and related roads. Not all wildlife species are as sensitive to roads and disturbance as these species. However, those that are the most sensitive often include species that are declining in numbers and distribution because of this sensitivity, such as sage-grouse and raptors, including ferruginous hawks (*Buteo regalis*). With respect to sage-grouse, recent research by Doherty, et. al. (2007) outlines the sensitivity of this species to CBNG development. CBNG development in Wyoming has displaced sage-grouse from crucial habitat and their population continues to decline as CBNG activity expands into previously undeveloped areas. These impacts are also likely to occur in the Montana portion of the PRB, even when timing limitations and avoidance areas are applied as BMPs. Table 4-69 provides estimates of the area of habitat within which species sensitive to disturbance and roads may be affected both within and around the perimeter of CBNG well fields. The table presents data on the size of areas which potentially are affected at both 1/2-mile and 2-mile perimeters around well fields (Fyfe and Olendorff 1976, Lyon 1983, Connelly et al. 2000).

Table 4-69 assumes well field development would include 8, 16, or 24 wells per square mile and that each well field would include 200 wells. CBNG well development is projected to occur over a 20-year period with an average well life of 20 years. Therefore, the information presented in Table 4-69 represents the maximum area of disturbance for sensitive wildlife species in year 20 when all wells would be developed and none closed. Approximately 44 percent of the wells and associated disturbance would be in place in year 5, 72 percent in year 10 and 87 percent in year 15. By year 20, indirect impacts of CBNG development would affect sensitive species of wildlife on between 880,000 and 4.7 million acres. Sagebrush obligate song birds, which are suffering range-wide population

declines, are also sensitive to disturbance and habitat fragmentation. They avoid pipeline and road corridors even when the roads are unpaved and receive little use (Ingelfinger 2001). His research in Wyoming natural gas fields found that the density of sagebrush obligates including Brewer's sparrow (*Spizella breweri*), sage sparrow (*Amphispiza belli*) and sage thrasher (*Oreoscoptes montanus*) were

TABLE 4-69

AREA OF DIRECT IMPACTS AND INDIRECT WILDLIFE DISTURBANCE AND DISPLACEMENT[1] WITHIN AND AROUND CBNG WELL FIELDS FOR MORE SENSITIVE WILDLIFE SPECIES FOR ALTERNATIVES B THROUGH G AND H

(ASSUMES 200 WELLS PER WELL FIELD, 8, 16, OR 24 WELLS PER SQUARE MILE[2])

		Indirectly Affected Area Within 1/2 Mile		Indirectly Affected Area Within 2 Miles	
Number of Wells Per Square Mile	Acres Per Well Field	Additional Area Affected Around Perimeter of Each Well Field	Total Affected Area Within Well Fields and Within 1/2 Mile of Well Field Perimeters[3]	Additional Area Affected Around Perimeter of Each Well Field	Total Affected Area Within Well Fields and Within 2 Miles of Well Field Perimeters[3]
		Acres	Acres	Acres	Acres
Alternatives B Through F and H[4]--18,300 Wells and 91.5 Well Fields					
8	16,000	7,040	2,108,160	35,840	4,743,360
16	8,000	5,120	1,200,480	28,160	3,308,640
24	5,312	4,352	884,256	25,152	2,787,456
Cumulative Impact of CBNG Development Only for Alternatives B Through F and H--26,500 Wells and 132.5 Well Fields					
8	16,000	7,040	3,052,800	35,840	6,868,800
16	8,000	5,120	1,738,400	28,160	4,791,200
24	5,312	4,352	1,280,480	25,152	4,036,480
Alternative G--6,470 Wells and 32.4 Well Fields					
8	16,000	7,040	746,496	35,840	1,679,616
16	8,000	5,120	425,088	28,160	1,171,584
24	5,312	4,352	313,114	25,152	987,034
Cumulative Impact of CBNG Development Only for Alternative G--14,670 Wells and 73.4 Well Fields					
8	16,000	7,040	1,691,136	35,840	3,805,056
16	8,000	5,120	963,008	28,160	2,654,144
24	5,312	4,352	709,338	25,152	2,236,058

[1]See text for discussion of individual and population level consequences of displacement.

[2]A larger average number of wells per field would reduce the affected area. For example, fields averaging 1,000 wells per field and 8 wells per square mile would impact 1,738,061 acres instead of 2,108,160 acres.

[3]Affected area around well fields assumes there is no overlap between affected areas of adjacent well fields. Overlap would reduce affected perimeter area.

[4]Although Alternatives F and H include 75 fewer predicted wells than Alternatives B through E, the total area of indirect disturbance is only slightly less. Consequently, Alternatives F and H are considered to have the same amount of indirect disturbance as Alternatives B through E.

reduced by 50 percent within 100 meters of lightly traveled unpaved roads compared to densities in undisturbed sagebrush communities. Sage sparrow density along a natural gas pipeline route with no traffic was 64 percent lower within 100 meters of the route compared to densities in nearby undisturbed sagebrush. Ingelfinger (2001) attributed these declines to noise (along the roads), habitat fragmentation, edge avoidance and possibly inter-specific competition with horned larks, a species that forages along roads. At full development there would be 6,680 miles of new roads. Assuming no overlap, 100 meters on each side of these roads would include over 530,000 acres and additional effective habitat loss would occur along pipelines. These lands are included in the information presented in Table 4-69.

Some additional direct and indirect impacts not described for Alternative A would be expected to occur under Alternative B because of the much greater scale of CBNG development. Prairie dog colonies tend to be located on relatively flat ground and often in valleys. Prairie dog towns also support much higher densities of birds and mammals and greater avian species richness than adjacent prairie (Agnew et al. 1986). Various studies have reported 163 vertebrate species using black-tailed prairie dog colonies in Montana including several species of concern such as burrowing owl and mountain plover (Reading et al. 1989, Tyler 1968, Clark et al 1982, Agnew 1986). Prairie dog colonies larger than 80 acres are protected from surface occupancy only if black-footed ferrets are found and this protection applies on BLM administered surface only.

Smaller colonies and larger colonies without ferrets would effectively receive no special protection on any lands. Considering the ferrets extreme rarity, it is unlikely that any prairie dog towns would be protected from impacts from CBNG development. However, due to the anticipated release of black-footed ferrets onto the Northern Cheyenne Reservation in 2008, the level of protection could increase. Road, well pad, pipeline and utility line placement across prairie dog towns would result in direct mortality and impact large numbers of species through habitat loss and displacement to unsuitable habitat, which would result in the loss of displaced individuals.

As discussed in the Hydrological Resources section, surface water bodies would not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seams. In the unlikely event there is a localized connection between a spring-fed stream and groundwater withdrawals, effects on wildlife and habitat would include reducing or even drying of springs and reduced flow and duration in intermittent and small perennial drainages. Reduced surface water would result in more xeric vegetation and would impact all types of wildlife, but would be especially important for amphibians and certain bird species that depend on mesic plant communities. Sage-grouse could suffer substantial impacts because broods spend much of July and August in more mesic sites as sagebrush habitats desiccate (Gill 1965, Savage 1969, Connelly and Markham 1983, Fischer et al. 1998). Reduced availability of mesic sites would reduce sage-grouse brood survival and unfavorably affect populations (Connelly et al. 2000).

There would be no differences between the direct and indirect impacts on BLM and state lands. Impacts on private lands could be much more substantial because stipulations and mitigation measures would not apply.

Federally Listed Species

Direct impacts to federally protected species are prohibited by law and would be the same as under Alternative A.

The potential for indirect impact would be greater under this alternative because of the much larger amount of habitat that would be disturbed or lost with the increased level of vegetation disturbance associated with the greater number of well pads, roads and utility lines. Increased roadways for more wells would result in greater human access, with the potential for more illegal harvest, indirect disturbance, or harassing of protected species. As many as 4.7 million acres of habitat for species sensitive to human disturbance may be indirectly affected by CBNG development (Table 4-69). Since federally listed species are often rare because of their sensitivity to human disturbance, it is unlikely that all potential indirect impacts would be avoided.

The same agency-applied mitigation measures described for Alternative A would apply to Alternative B. The effect of these mitigation measures on impacts would also be the same as under Alternative A.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative B and be the result of developments in close proximity to reservation boundaries.

Within the boundaries of the reservation, regulations related to wildlife would be under the jurisdiction of

tribal Laws and not state or federal laws. Full-scale development forecast under this alternative would increase the risk of impacts to wildlife on the reservation.

Wildlife vulnerability to impacts would be similar to that presented in Table 4-69. Indirect impacts of this level of CBNG development on the Crow reservations on species sensitive to human disturbance are shown in Table 4-69 under cumulative impacts.

Northern Cheyenne Reservation

There would be no direct impacts to wildlife on the Northern Cheyenne Reservation from off-reservation development. Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative B and be the result of developments near reservation boundaries.

Conclusions

The same types of impacts described for wildlife and species of concern under Alternative A would be expected. However, the extent of impacts would be about 20 times greater in area and scope because of greater CBNG well development and associated direct and indirect impacts. Stipulations would avoid some impacts for certain species. However, they would not be 100 percent effective because some stipulations do not apply to operations and non-CBNG human activities that would be facilitated by new CBNG roads. The potential for impacts is high under Alternative B because of the large number of CBNG wells.

Cumulative Impacts

Cumulative impacts would be similar to those described for Alternative A except that the impacts from Montana CBNG development would be substantially greater. Additionally if CBNG development were to occur on the Crow and Northern Cheyenne Reservations and in the Custer National Forest the development is expected to result in the direct short-term loss of an additional 25,000 acres and long term loss of about 14,750 acres. Degraded habitat value of reclaimed lands would be similar to that described for Alternative A. Other actions considered to be cumulative impacts would result in the long term loss of an additional 41,000 acres.

Table 4-69 estimates additional cumulative indirect impacts of more CBNG development on species sensitive to human activities and development. It is estimated cumulative indirect impacts of CBNG development in Montana could affect sensitive wildlife on between 1.28 and 6.87 million acres. Since sensitive and federally listed species are often rare because of their sensitivity to human disturbance, it is unlikely that all potential indirect impacts would be avoided.

Alternative C—Emphasize CBNG Development

The same types of impacts on wildlife described for Alternatives A and B would occur under Alternative C. However, Alternative C would have direct impacts on more acres of wildlife habitat than Alternative B because Alternative C includes fewer measures to reduce impacts. Table 4-66 in the *Vegetation* section notes the number of acres of direct impact (habitat loss) and the number of miles of roads and pipeline and utility corridors that would result from CBNG development under Alternative C. Development under Alternative C would result in the direct short term loss of about 70,000 acres of wildlife habitat to well pads, roads (9,018 miles versus 6,680 miles for Alternative B) and pipeline and utility corridors (27,917 miles versus 20,679 miles for Alternative B). More land would be directly impacted because roads would not be required to follow existing corridors and there would be no requirement to place pipelines and utilities in corridors. Long term habitat loss would affect about 47,600 acres and reclaimed areas would have reduced habitat value. Direct and indirect impacts on wildlife from this scale of development would be widespread.

Table 4-69 estimates the area on which sensitive species of wildlife would be disturbed by CBNG development under Alternative C. Indirect disturbance and effective habitat loss for sensitive species would be the same as under Alternative B and would indirectly affect sensitive wildlife on between 880,000 and 4.7 million acres. Effects of disturbance were described under Alternative A.

CBNG development produces excess surface water that has not been available in the past. It is unlikely that this water would go unused. Information in the *Water Resources Technical Report* (ALL 2001b) indicates that virtually all of the water produced during CBNG extraction would be suitable for livestock or wildlife use. Cattle typically move up to 0.6 mile from water to graze in steep terrain, but will move up to two miles in relatively flat areas (Stoddart et al. 1975). CBNG development areas that are greater than 0.6 to two miles from natural or currently developed perennial water sources, depending on terrain, are either not used or used lightly by livestock on a seasonal basis. Increased stock water availability from CBNG-produced water would permit private land owners and state and BLM grazing permittees to adjust the distribution and management of their herds to use

more of the forage within 0.6 to two miles of CBNG wells. Each CBNG production well field that is located in an area without current perennial water sources could make up to several thousand acres available to more intensive cattle grazing. Utilization would be most intensive in the immediate vicinity of the water discharge location wells. Increased livestock grazing reduces forage otherwise available for wildlife and degrades habitat value for many species of wildlife (Saab et al. 1995). The additional CBNG water would also be available for wildlife use.

The release of untreated CBNG water to surface drainages and streams could result in serious erosion, damaging or destroying instream and stream bank riparian vegetation that constitutes valuable wildlife habitat (Regele and Stark 2000). The erosion can result in increased sediment loads, which along with the potential high salinity and sodicity, can degrade the stream and impact riparian vegetation. Impacts of discharging sodic CBNG waters would likely be greatest in intermittent and smaller perennial drainages during low-flow periods. Releases during low-flow periods of late summer and fall would have the greatest potential to impact riparian habitat and sensitive wildlife species such as amphibians. This is also the time when this vegetation is naturally stressed because of low water and amphibians are confined to remaining water or are burrowed into shallow mud. The potential for impacts on riparian habitat and amphibians exists along drainages and streams throughout the CBNG development area.

Because of the typically low flows of the CBNG wells (approximately 5 to 10 gallons per minute), it is likely that these impacts would be localized in the vicinity of the discharge, unless flow were collected from a large number of wells, which may occur. There are no apparent differences between the direct and indirect impacts on BLM-administered and state lands. Impacts on private lands would be much more substantial because stipulations and mitigation measures would not apply.

Species of Concern

Direct impacts to federally protected species are prohibited by law and are the same as under Alternatives A and B.

The potential for indirect impacts or modification to habitat would be greater under this alternative than for Alternative B (Table 4-69) because fewer potential impacts would be avoided. Reclamation of disturbed areas would not necessarily restore sites to previous habitat configurations or specific habitat needs of listed species. This alternative would have the greatest acreage of disturbance from roadways, pipelines and utilities of any alternative. Power line strike hazards are highest with this alternative. This alternative may affect SAR levels in rivers that would affect BLM and state species of concern and bald eagle foraging, interior least tern foraging success and nesting habitat. Production water disposal could also develop riparian areas that would be lost after abandonment. If listed species come to rely on these areas of developed habitat, this would lead to future declines when the water source for them no longer exists.

Crow Reservation

Impacts to the Crow Reservation would be similar to the indirect impacts described in general for Alternative C. These indirect impacts would occur in areas adjacent to off-reservation CBNG developments.

Northern Cheyenne Reservation

Since there is no tribally sponsored CBNG development, impacts to the Northern Cheyenne Reservation would be similar to the indirect impacts described in general for Alternative C. These indirect impacts would occur in areas adjacent to off-reservation CBNG developments.

Conclusions

The same types of impacts described for Alternatives A and B for wildlife and the same as described for Alternative B for sensitive species would be expected. However, impacts would be at a greater level due to the emphasis on CBNG production under Alternative C. Approximately 21,000 more acres would be directly impacted in both the short and long term compared to Alternative B.

Cumulative Impacts

The types of cumulative impacts would be the same as described for Alternatives A and B. CBNG development is expected to result in the direct short and long term loss of an additional 21,000 acres compared to Alternative B. Degraded habitat value of reclaimed lands would be similar to that described for Alternative A. Other actions considered to be cumulative impacts would result in the long term loss of an additional 41,000 acres.

Table 4-69 estimates additional cumulative indirect impacts of more CBNG development on species sensitive to human activities and development. It is estimated cumulative indirect impacts of CBNG development in Montana could affect sensitive wildlife on between 1.28 and 6.87 million acres. Since sensitive and federally listed species are often rare because of

their sensitivity to human disturbance, it is unlikely that all potential indirect impacts would be avoided.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

The same types of direct and indirect impacts on wildlife described for the Alternatives A and B and in Tables 4-68 and 4-69 would occur under Alternative D. Areas affected by direct and indirect impacts would be similar to those reported for Alternative B with the additions noted below. The impacts of the beneficial use of water for livestock grazing described for Alternative C would also occur under Alternative D. Unlike Alternative C, CBNG water discharged under Alternative D would be treated before release. Additional treated water provided to intermittent and small perennial streams may result in both impacts and benefits, depending mostly on the volume of discharge water relative to the natural flow, the steepness of the terrain and the erodibility of the soil. Relatively high volumes of water discharged into smaller drainages could erode the channel, destroying riparian vegetation either directly or as a result of channel down-cutting, which would reduce water availability to plants. Intermittent water sources that become perennial because of CBNG discharge would attract grazing livestock for longer periods of the year, resulting in reduced forage and cover for wildlife. Increased flows may also result in improved and more extensive riparian vegetation in intermittent drainages where seasonal water stress limits the current extent or condition of the vegetation and in more widespread water availability for wildlife. However, this benefit would be offset if more livestock grazing occurs in the vicinity and downstream of the discharge points. Lack of a requirement to reclaim roads and abandoned reservoirs would increase the potential for noxious weed occurrence and resulting habitat degradation.

There are no apparent differences between the types of direct impacts on BLM or state lands. Furthermore indirect impacts would have very little difference between BLM and state managed lands. Impacts on private lands would be much more substantial because stipulations and mitigation measures would not apply.

The same agency-applied mitigation measures described for Alternative B would apply to Alternative D. The effect of these mitigation measures on impacts would also be the same as under Alternative B.

Species of Concern

Direct impacts to federally protected species are prohibited by law and are the same as under Alternative A. The potential for indirect impacts or modification to habitat would be greater under this alternative than Alternatives A or B, but less than Alternative C. As with those alternatives, reclamation of disturbed areas would not necessarily restore sites to previous habitat configurations or specific habitat needs of listed species. There would be increased roadways with this alternative over either Alternatives A or B. As with Alternative C, production water disposal, which would be treated under this alternative, could develop riparian areas that would be lost following abandonment.

Mitigation is the same as for Alternative B.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative B. However, since there would be no tribal sponsored development, impacts would be limited to adjacent boundaries from off-reservation development. Small areas of private development on the reservation would cause direct impacts similar to those described in Alternative D, but adjusted for the limited scale of development.

Northern Cheyenne Reservation

Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative B and are expected to occur in areas adjacent to off-reservation development. No tribal sponsored CBNG development is anticipated for this alternative and therefore no direct impacts to wildlife are expected to occur on the Reservation.

Conclusions

Direct, indirect and residual impacts on wildlife would be similar to those described for Alternative B.

Under all alternatives, the variety of life forms and the large number of species of concern, the lack of specificity of project locations and the wide variation in habitat used by these species preclude the ability to identify specific impacts to each individual species of concern. Exploration and development of CBNG wells would result in a variety of direct and indirect impacts to species of concern. Specific impacts would depend on the species, the amount and type of habitat removed and the nature and period of disturbance. Leasing stipulations as discussed above would reduce or avoid some impacts to federally listed and other sensitive species. However, there are no stipulations for most species of concern.

Cumulative Impacts

Cumulative impacts would be similar to those described for Alternative B.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

The types of impacts on wildlife under Alternative E would be similar to those described in Alternative A. However, the magnitude of the impacts would be substantially higher because the level of development would be much higher, as shown on Table 4-69. Examples of types of impacts similar to Alternative A follow:

- Direct habitat loss and direct and indirect impacts because of habitat disruption and wildlife disturbance caused by roads, pipelines and utility corridors would cause the bulk of the impacts on wildlife.
- Direct impacts would include loss of habitat to accommodate project features. They would persist for the duration of CBNG activities and, in the case of loss of habitat value, beyond that time. Some degree of habitat loss and degradation would continue following CBNG abandonment because of ecological differences between reclaimed sites and native vegetation.
- Based on the average area expected to be disturbed by exploration and development of each CBNG well, Alternative E would result in the direct disturbance of 73,860 acres resulting from development of 18,300 wells, 9,018 miles of roads and 27,917 miles of utility corridors (Table 4-66). Direct impacts on wildlife would also include mortality as relatively less mobile small mammals, reptiles and amphibians are killed during road and other site construction. Smaller mammals, reptiles and amphibians are most likely to be directly killed by vehicles and are vulnerable when crossing roadways (USDI and USDA 2001).
- Additional direct impacts would occur on private lands because state and federal lease stipulations are recommended but not required.
- Table 4-68 indicates the relative level of vulnerability of different representative types of wildlife to direct and indirect impacts. Most indirect impacts on wildlife would occur during all CBNG phases on BLM, state and private lands. The duration of effects would correspond with the duration of each phase and the intensity of activity during that phase. The relative magnitude of impacts would be directly related to the nature and extent of activities associated with each phase of CBNG development. Some indirect effects would persist beyond abandonment because continued human use of some CBNG and user-created roads that are not closed and reclaimed (USDI and USDA 2001).
- Table 4-68 provides estimates of the area of habitat within which species sensitive to disturbance and roads may be affected both within and around the perimeter of CBNG well fields. Potentially affected areas are estimated for both 1/2-mile and 2-mile perimeters around well fields and related activity (Fyfe and Olendorff 1976, Lyon 1983, Connelly et al. 2000). The information presented in Table 4-69 represents the maximum area of disturbance for sensitive wildlife species in year 20 when all wells would be developed and none would have been closed. By year 20, indirect impacts of CBNG development would affect sensitive species of wildlife on between 880,000 and 4.7 million acres. Species sensitive to indirect impacts at this scale were discussed under Alternative A.
- Overhead power lines constructed for production wells pose problems for a variety of wildlife species. Raptors, sage-grouse and other species of birds occasionally collide with power lines, especially during periods of relatively poor visibility. Overhead power lines can benefit some raptors in open country by providing hunting perches. However, the additional perches also result in local population declines in prey species. For example, overhead power lines constructed in the vicinity of sage-grouse and sharp-tailed grouse leks and wintering areas can substantially increase predation rates on the grouse. The risk of raptor electrocution on federal and state lands is small because the BLM and State require power lines and poles be constructed to standards that would avoid raptor electrocution (APLIC 2006). Raptor and sage-grouse collisions with power lines have also been noted throughout the west including eastern Montana.
- Stipulations prohibit surface occupancy in riparian areas and on floodplains of major rivers. However, they do not prohibit crossing of streams or construction of roads through riparian areas. Roads constructed through riparian areas and other forest and shrub stands for CBNG development and operation create edge effects and alter the physical environment (Trombulak and Frissell 2000). Roads create drier conditions in the vicinity of the road, thereby altering habitat for many species. In grassland and shrubland habitats, trails

and roads create edge habitat for predators and reduce patch size of remaining habitat for area-sensitive species (USDI and USDA 2001, Ingelfinger 2001). Swihart and Slade (1984) found that prairie voles (*Microtus ochrogaster*), which occur in the Planning Area, were reluctant to cross tire tracks running through an open field. Reluctance to cross narrow gravel roads has also been observed in white-footed mice (*Peromyscus leucopus*), which also occur in the Planning Area and many other rodent species (Mader 1984, Merriam et al. 1989, Oxley et al. 1974). Consequently, roads can function as barriers to population dispersal and movement for small mammals that occur in the Planning Area.

- The assumption is made that existing stipulations would provide some protection to sage-grouse habitat including lek areas, nesting habitat and winter range. It is recognized that these actions would not completely protect this species. Mitigation measures within the WMPP will provide additional protective measures. Lease stipulations and terms and conditions would provide protection to raptors and the mountain plover. Implementation of protective measures contained in the WMPP would help reduce, but cannot avoid all, impacts to all species of wildlife including sagebrush-obligate birds.

See Alternative A for a complete discussion of the types of impacts on wildlife expected from CBNG development, including impacts on threatened and endangered and candidate species.

Alternative E has the potential to have a greater magnitude of impacts than Alternatives B and D, due to the larger area directly disturbed and the higher mileage of road, pipeline and utility corridors constructed. However, implementation of BLM required Conditions of Approval and the WMPP would help to reduce wildlife impacts.

Project Plans would be developed and approved using the programmatic guidance outlined in the WMPP. They would include baseline inventory for sensitive wildlife and habitats in areas where such inventories have not been completed. Certain broad landscape level inventories would be conducted by the BLM. The BLM or Operators would conduct additional, more detailed inventories and monitoring. Operators would be required to submit plans that demonstrate how their project design minimizes or mitigates impacts to surface resources and meets objectives for wildlife before exploration and approval of the APD. The WMPP would be a cooperative approach that incorporates adaptive management principles to try to deal with impacts as they occur. The WMPP also establishes a framework that encourages industry, landowners and agencies to work together constructively to incorporate conservation measures into CBNG development. All CBNG development would follow the programmatic guidance to address wildlife concerns and each individual Project Plan would include a site-specific Monitoring and Protection Plan which includes mitigation specific to species or local habitats. Over the life of the CBNG project, monitoring and evaluation through area specific WMPPs would offer some insight as to the effectiveness and failures of management actions and therefore encourage adaptive strategies to address specific and unforeseen problems.

Some examples of how the WMPP would be applied are described below. It must be recognized however, that because of the scale of CBNG development proposed under this alternative, it would only be possible to reduce or lessen impacts to important wildlife habitats utilizing measures described in the WMPP.

As discussed in alternative A, the primary objective of reclamation is to restore vegetative cover to the disturbed site. With the required seed mixes, restoration to near-native conditions is not likely to occur. However, flexibility provided by the WMPP allows for more creative options in reclamation plans to restore important wildlife habitats. An example would be to focus on restoration of sagebrush stands on big game winter ranges as opposed to establishing herbaceous cover only.

As part of the approval process for project protection plans, location and use of roads would be a very high focus. Project design would include locating roads in such a manner as to avoid crucial big game and sage-grouse winter ranges (i.e. south facing slopes, sagebrush flats and valley floors), raptor nesting areas and prairie dog towns. Additionally, stipulations may be applied that preclude use of these roads during critical time periods of the year (seasonal restrictions) or day (timing restrictions) that would apply to all CBNG activities.

The power infrastructure associated with CBNG development is identified as a major wildlife impact. Agencies already require all powerlines to be raptor proof according to accepted standards. However, additional stipulations may be required based on site specific needs. Examples of this may be locating powerlines away from sage-grouse leks and winter concentration areas, burying powerlines in crucial areas and applying more aggressive raptor-proofing options than previously required.

Mandatory mitigation measures are listed in Chapter 2.

Species of Concern

The types of direct and indirect impacts would be similar to the other development alternatives. Alternative E has the potential to have a greater magnitude of impacts to species of concern than Alternatives B and D, due to the larger area that would be directly disturbed and the higher mileage of road, pipeline and utility corridors to be constructed. However, implementation of BLM required COAs and the WMPP would help to reduce impacts to species of concern.

The WMPP addresses guidance for developing Plans of Development. Project Plans and conservation measures applied as Conditions of Approval provide a full range of practicable means to avoid or minimize harm to wildlife species or their habitats. Operators would minimize impacts on wildlife by incorporating applicable WMPP programmatic guidance into Project Plans. Not all measures may apply to each site-specific development area and means to reduce harm are not limited to those identified in the WMPP. BLM and MFWP would work together to collect baseline information about wildlife and sensitive habitats possibly containing special status species.

The WMPP is intended to reduce potential impacts on a variety of sensitive species by requiring inventories prior to exploration. This action would likely reduce potential direct impacts on sensitive species and may also reduce potential indirect impacts in some cases. However, given the scale of CBNG development, it is very unlikely that all direct and indirect impacts on species of concern can be avoided. Monitoring findings may result in additional conditions of approval and mitigation measures for CBNG development that occurs after initial monitoring data are collected and analyzed, which could further reduce, but not eliminate, potential impacts on sensitive species.

Alternative E does include indirect potential West Nile virus impacts to sage-grouse that would not occur under Alternatives B, C and D. Specifically, Alternative E would include approximately 8,285 infiltration and evaporation ponds, each assumed to be about 5 acres in size that could serve as sources for the mosquito (*Culex tarsalis)* responsible for the spread of the West Nile virus. An on-going study by researchers at Montana State University has indicated this mosquito thrives in CBNG holding ponds in northern Wyoming (Montana State University News Service 2005). Measures to minimize the exploitation of the CBNG ponds by breeding mosquitoes are included in the WMPP and would be implemented under Alternative E.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative E. Impacts would be limited to adjacent boundaries from off-reservation development.

Northern Cheyenne Reservation

Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative E. Specific mitigation measures proposed by the Northern Cheyenne Tribe that would be implemented by the BLM are described in the Northern Cheyenne Mitigation Appendix.

Conclusions

The types of direct, indirect, residual and cumulative impacts would be generally the same as those noted for Alternatives A and B. Discharge of treated water to intermittent and small perennial streams would result in both impacts and benefits to aquatic/riparian vegetation, amphibians, aquatic wildlife and invertebrates; depending mostly on the volume and quality of discharge water relative to the natural flow.

Impacts to wildlife from habitat loss, wildlife disturbance and mortality, including illegal harvest, have the potential to be greater under this alternative than either Alternatives B or D (Table 4-66). However, as mentioned earlier, implementation of the WMPP would reduce direct and indirect effects to wildlife.

All wildlife species would be impacted at some level by habitat changes caused by the replacement of pre-disturbance vegetation with lesser diversity of vegetation following reclamation, increased access through increased roads and other indirect effects. However, implementation of stipulations, the WMPP and adaptive management should ensure species do not decline to the point they nced protection of the ESA. Recent research (Holloran and Anderson 2004, Holloran 2005); and ongoing studies specific to CBNG development in the Powder River Basin indicate potential for declining local populations of sage-grouse under this alternative. For federally-listed species, some effects may occur, but effects are not likely to cause adverse population responses.

The magnitude of cumulative impacts would be similar to those described for Alternative C.

Alternative F—Phased Development Multiple Screens (High Range)

Under this alternative, the type of impacts to wildlife would be similar as the other development alternatives. However, the magnitude of direct impacts is expected to be less than the other action alternatives for the

following reasons: (1) as with Alternatives B and D, Alternative F provides restrictions on the amount of surface disturbance on federal leases within crucial habitat areas; (2) Alternative F (as with Alternative E) includes additional conservation measures described in the WMPP; (3) Alternative F includes thresholds on impacts to crucial habitats, which would reduce impacts to sagebrush and grassland obligated species; (4) Alternative F includes sage-grouse habitat conditions for protecting crucial habitat areas and avoiding the displacement of sage-grouse; and (5) Alternative F includes phasing of development that would result in a lesser magnitude of impact for a particular area over time.

The threshold component of Alternative F would limit the amount of impacted habitat on BLM-administered surface or on private surface overlaying federal minerals within each 4th Order watershed. The threshold value would allow no more than 20 percent of any crucial habitat area within to be directly impacted over a 20-year period within the watershed. This would include removal of crucial habitat (e.g., nesting, brood-rearing and wintering habitats), resulting from the proposed project activities, a 400 meter corridor along major travel routes (12 or more vehicles per day) and other unrelated projects that result in habitat removal. Best available science (including any information available from ongoing research, modeling and other sources), combined with documentation specific to POD-level analysis, would be used to document existing crucial habitat and impact areas. Research is currently being conducted within the Powder River Basin of Montana and Wyoming, specifically on sage-grouse and habitat use.

Implementation of this threshold would have little effect on protecting species or habitats, as it is unlikely disturbance would reach the 20 percent threshold over a 20-year period. In addition, seasonal restrictions do little to protect wildlife beyond the time period development takes place. Operation and maintenance of wells are not precluded by this stipulation, which often result in impacts to habitat in which the stipulations were intended to protect. The "adaptive management" feature (identified in Chapter 2 and expanded in the Wildlife Monitoring and Protection Plan in the Wildlife Appendix) would increase BLM's ability to modify the threshold percentage if needed, to reduce the magnitude and level of habitat impacts. The adaptive management approach would include utilizing and evaluating new information to form additional or to change conditions of approvals. Important information such as the on-going sagebrush/sage-grouse research in CBNG (pre and post) development areas in Montana and Wyoming, would be utilized.

BLM would manage sage-grouse habit using a combination of the stipulations attached to the oil/gas leases, management identified in the 20/20 wildlife screen and stipulations identified in the WMPP. This alternative, while developed using the best information available at the time, would likely result in a significant loss of sag-grouse habitat in the areas of and directly development.

For indirect impacts, new information (relative to the Statewide Document) is presented in Table 4-70. The table provides information by watershed, as Alternative F includes maximum thresholds for impacts based on the watershed scale. For the entire Planning Area, total acres of indirect impacts are different between Table 4-69 and Table 4-68 because Table 4-69 is based on slightly different assumptions regarding well development. Specifically, the indirect impacts (calculated in Table 4-69) assume all wells will be developed at the same density (8, 16, or 24 wells per square mile) while Table 4-70 incorporates recent experience indicating that well site density can vary depending on the available coal layers. Well site density is a more accurate measurement because existing well sites may have as many as five wells.

Taken together, Tables 4-69 and 4-70 provide a range of expected indirect impacts from the development alternatives. Note that in all cases, the tables indicate total acres of indirect impacts are the same under all action alternatives. In reality, acreages of indirect impacts from Alternative F are expected to be less, given the habitat and development thresholds that are part of this alternative. In addition, note that indirect effects from new utility lines, pipelines and roads would not be the same under each alternative. Specifically, Alternatives B, D and F would have fewer indirect impacts from utility lines, pipelines and roads, since these alternatives include more restrictions on their development than the other action alternatives. Types of indirect effects on wildlife from roads, pipelines and utility lines are described above in the discussion of Alternative A.

Species of Concern

For the same reasons as described above, Alternative F would include the same types of direct and indirect impacts to species of concern as described in the other development alternatives (B, C, D and E) but at a lesser magnitude. Under Alternative F, thresholds for impacts to crucial habitat would provide unique protection compared to the other development alternatives. Fragmentation of habitat, dispersal, colonization and extinction patterns would be reduced under this alternative. In addition, Alternative E discussed potential indirect effects to sage-grouse from holding ponds and risk of West Nile virus infection.

TABLE 4-70

AREA OF POTENTIAL INDIRECT WILDLIFE DISTURBANCE AND DISPLACEMENT WITHIN AND AROUND STANDARD-SIZED[1] CBNG WELL FIELDS FOR MORE SENSITIVE WILDLIFE SPECIES BY 4TH ORDER WATERSHED, ALTERNATIVES B, C, D, E, F AND H

Watershed	Acres in Montana	Number of Production Wells per Watershed (Assuming 10% are Dry Holes)	Well Fields per Watershed[2]				Additional Acreage of Indirect Disturbance within 1/2 mile of Well Field Perimeters[3,4]	Total Indirect Disturbance[1] within Well Fields	Total Indirect Disturbance from CBNG Development[4]	Percentage of Watershed in Montana Indirectly Disturbed
			200 Wells per Field, 8 Wells per Square Mile	400 Wells per Field, 16 Wells per Square Mile	600 Wells per Field, 24 Wells per Square Mile	Total Number of Standard Sized Well Fields				
Clark's Fork Yellowstone	978,374	405	2.0	0.0	0.0	2.0	14,256	32,400	46,656	4.77%
Little Bighorn	830,773	608	3.0	0.0	0.0	3.0	21,402	48,640	70,042	8.43%
Little Powder	416,598	180	0.9	0.0	0.0	0.9	6,336	14,400	20,736	4.98%
Lower Bighorn	1,266,927	720	3.6	0.0	0.0	3.6	25,344	57,600	82,944	6.55%
Lower Tongue	1,835,479	3,105	7.8	3.9	0.0	11.6	81,972	186,300	268,272	14.62%
Lower Yellowstone-Sunday	3,062,384	1,530	7.7	0.0	0.0	7.7	53,856	122,400	176,256	5.76%
Middle Musselshell	1,223,591	90	0.5	0.0	0.0	0.5	3,168	7,200	10,368	0.85%
Middle Powder	454,527	1,890	6.6	1.4	0.0	8.0	56,549	128,520	185,069	40.72%
Mizpah	510,281	113	0.6	0.0	0.0	0.6	3,978	9,040	13,018	2.55%
Rosebud	834,998	3,240	12.2	2.0	0.0	14.2	99,792	226,800	326,592	39.11%
Stillwater	521,362	90	0.5	0.0	0.0	0.5	3,168	7,200	10,368	1.99%
Upper Musselshell	2,570,399	68	0.3	0.0	0.0	0.3	2,394	5,440	7,834	0.30%
Upper Tongue	586,044	3,465	0.0	4.3	2.9	7.2	50,820	115,500	166,320	28.38%
Upper Yellowstone-Lake Basin	1,003,984	720	3.6	0.0	0.0	3.6	25,344	57,600	82,944	8.26%
Upper Yellowstone-Pompey's Pillar	1,279,948	180	0.9	0.0	0.0	0.9	6,336	14,400	20,736	1.62%
TOTAL		16,403	50.0	11.7	2.9	64.6	454,714	1,033,440	1,488,154	

[1] For this table, a standard-sized well field is considered to be 200 well sites with an 80-acre spacing, which results in a total standard field size of 16,000 acres. Number of wells and acres of disturbance for Alternative F represent the maximum development for this alternative. In reality, Alternative F may include a lesser acreage of effect, due to the threshold limits and implementation of the WMPP that is part of this alternative.

[2] When more than one layer of coal is present, wells can be co-located on the surface within the same 80-acre spacing. The following watersheds have multiple coal layers: Lower Tongue, 50% with 2 layers; Middle Powder, 30% with 2 layers; Rosebud, 25% with 2 layers; and Upper Tongue, 50% with 2 layers, 50% with 3 layers.

[3] The additional acreage within 1/2 mile of a standard-sized well field (16,000 acres) is approximately 7,040 acres (see Table 4-68).

[4] These acreages assume there is no overlap between affected areas of adjacent well fields. Overlap would reduce the total area of indirect disturbance outside well field perimeters.

Note that Alternative F could include as many holding ponds as Alternative E only if the development thresholds were not met under Alternative F.

Crow Reservation

Types of indirect impacts to wildlife on the Crow Reservation would be similar to those described in general for the development alternatives. However, the phased aspect of development, the threshold on disturbance of crucial habitats and adaptive management techniques would result in reduced indirect impacts to Crow Reservation wildlife, relative to Alternatives B, C, D and E.

Northern Cheyenne Reservation

Effects to Northern Cheyenne Tribe wildlife resources would be similar to that described for the Crow Reservation.

Conclusion

Under this alternative, cumulative impacts would be less than Alternative E, primarily due to the implementation of cumulative and watershed-specific numerical limits on the number of federal CBNG APDs approved per year.

All wildlife species would be impacted at some level by habitat changes caused by vegetation removal not reclamation to predisturbance conditions, increased access through increased roads and other indirect effects. However, implementation of stipulations, the WMPP, development thresholds and adaptive management would help ensure species do not decline to the point needing protection of the ESA. An exception to this finding is uncertainty concerning declines of sage-grouse populations. Recent research (Holloran and Anderson 2004, Holloran 2005); and ongoing studies specific to CBNG development in the Powder River Basin indicate potential for declining local populations of sage-grouse under this alternative. Most significantly is the finding related to the need to minimize disturbance to large tracts of remaining high quality sagebrush communities. For federally-listed species, some effects may occur, but are not likely to cause adverse population responses.

Alternative G—Phased Development Multiple Screens (Low Range)

This alternative would include the same type of impacts as the other development alternatives. However, the magnitude of direct and indirect effects to wildlife would be less than all other development alternatives (Alternatives B, C, D, E and F), due to the lower level of well development. As with Alternative F, Alternative G includes conservation measures as described in the WMPP that would also reduce direct and indirect effects to wildlife. Alternative G also includes the same thresholds levels for impacts as Alternative F. However, given the relatively low level of development under Alternative G, these thresholds may never be met under this Alternative. Alternative G would directly affect 19,665 acres, compared to 55,210 acres to 73,860 acres that would be directly affected under Alternatives B through F (Table 4-66). Total acres of habitat indirectly disturbed under Alternative G would be approximately one-third that of the other development alternatives (Tables 4-70 and 4-71).

As with Alternatives B, D and F, Alternative G would have fewer indirect impacts from utility lines and pipelines than Alternatives C and E. Alternative G includes fewer CNBG road miles than any other development alternative and consequently, direct and indirect effects to wildlife from roads would be less under this alternative.

Species of Concern

Given the lower level of well development and roads and the inclusion of the WMPP conservation measures under Alternative G, this alternative would have less direct and indirect effect on species of concern than Alternatives B, C, D, E, or F. However, the risk of West Nile virus to sage-grouse would be greater than Alternatives B, C and D, but less than Alternatives E or F.

Crow Reservation

Types of indirect impacts to wildlife on the Crow Reservation would be similar to indirect effects described in the other development alternatives. However, the magnitude of indirect impacts would be less than all other development alternatives due primarily to the lower level of well development under Alternative G.

Northern Cheyenne Reservation

Effects on Northern Cheyenne Tribe wildlife resources would be the similar to those described for the Crow Tribe.

TABLE 4-71

AREA OF POTENTIAL INDIRECT WILDLIFE DISTURBANCE AND DISPLACEMENT WITHIN AND AROUND STANDARD-SIZED[1] CBNG WELL FIELDS FOR MORE SENSITIVE WILDLIFE SPECIES BY 4TH ORDER WATERSHED UNDER ALTERNATIVE G

Watershed	Acres in Montana	Number of Production Wells per Watershed (Assuming 10% are Dry Holes)	Well Fields per Watershed[2]				Additional Acreage of Indirect Disturbance within 1/2 mile of Well Field Perimeters[3,4]	Total Indirect Disturbance[1] within Well Fields	Total Indirect Disturbance from CBNG Development[4]	Percentage of Watershed in Montana Indirectly Disturbed
			200 Wells per Field, 8 Wells per Square Mile	400 Wells per Field, 16 Wells per Square Mile	600 Wells per Field, 24 Wells per Square Mile	Total Number of Standard Sized Well Fields				
Clark's Fork Yellowstone	978,374	153	0.8	0.0	0.0	0.8	5,386	12,240	17,626	1.80%
Little Bighorn	830,773	216	1.1	0.0	0.0	1.1	7,603	17,280	24,883	3.00%
Little Powder	416,598	63	0.3	0.0	0.0	0.3	2,218	5,040	7,258	1.74%
Lower Bighorn	1,266,927	252	1.3	0.0	0.0	1.3	8,870	20,160	29,030	2.29%
Lower Tongue	1,835,479	1,089	2.7	1.4	0.0	4.1	28,750	65,340	94,090	5.13%
Lower Yellowstone-Sunday	3,062,384	540	2.7	0.0	0.0	2.7	19,008	43,200	62,208	2.03%
Middle Musselshell	1,223,591	36	0.2	0.0	0.0	0.2	1,267	2,880	4,147	0.34%
Middle Powder	454,527	666	2.3	0.5	0.0	2.8	19,927	45,288	65,215	14.35%
Mizpah	510,281	36	0.2	0.0	0.0	0.2	1,267	2,880	4,147	0.81%
Rosebud	834,998	1,143	4.3	0.7	0.0	5.0	35,204	80,010	115,214	13.80%
Stillwater	521,362	36	0.2	0.0	0.0	0.2	1,267	2,880	4,147	0.80%
Upper Musselshell	2,570,399	27	0.1	0.0	0.0	0.1	950	2,160	3,110	0.12%
Upper Tongue	586,044	1,215	0.0	1.5	1.0	2.5	17,820	40,500	58,320	9.95%
Upper Yellowstone-Lake Basin	1,003,984	270	1.4	0.0	0.0	1.4	9,504	21,600	31,104	3.10%
Upper Yellowstone-Pompey's Pillar	1,279,948	81	0.4	0.0	0.0	0.4	2,851	6,480	9,331	0.73%
TOTAL		**5,823**	**17.9**	**4.1**	**1.0**	**23.0**	**161,893**	**367,938**	**529,831**	

[1] For this table, a standard-sized well field is considered to be 200 well sites with an 80-acre spacing, which results in a total standard field size of 16,000 acres.

[2] When more than one layer of coal is present, wells can be co-located on the surface within the same 80-acre spacing. The following watersheds have multiple coal layers: Lower Tongue, 50% with 2 layers; Middle Powder, 30% with 2 layers; Rosebud, 25% with 2 layers; and Upper Tongue, 50% with 2 layers, 50% with 3 layers.

[3] The additional acreage within 1/2 mile of a standard-sized well field (16,000 acres) is approximately 7,040 acres (see Table 4-68).

[4] These acreages assume there is no overlap between affected areas of adjacent well fields. Overlap would reduce the total area of indirect disturbance outside well field perimeters.

Conclusion

Under this alternative, cumulative impacts would be less than the other development alternatives, primarily due to the reduced level of well development under Alternative G.

All wildlife species would be impacted at some level by habitat changes caused by vegetation removal not fully recovered with reclamation to predisturbance conditions, increased access through increased roads and other indirect effects. However, implemcntation of stipulations, the WMPP, development thresholds and adaptive management would help ensure species do not decline to the point of needing protection under the ESA. For federally-listed species, some effects may occur, but effects are not likely to cause adverse population responses.

Alternative H—Preferred Alternative - Multiple Screens

For wildlife, restrictions on CBNG development would be similar to Alternative F, but would incorporate adaptive management to identify conditions of approval (COAs), BMPs and alternative development schemes, based on available science and monitoring information (see the WMPP). BLM would work with CBNG operators, surface owners, Native American tribes, FWS and MFWP to identify any additional protection measures necessary. On split estate lands, BLM recognizes that achieving the objectives of this alternative would require cooperation with surface owners.

Specifically, this alternative includes (1) changes in management if mule deer or pronghorn populations decline by more than 30 percent in a 3-year period, (2) management modification if monitoring data indicate a change in wildlife species populations within crucial habitats on or adjacent to POD areas where federal mineral ownership occurs for Tier 1 species identified in the Montana Comprehensive Fish and Wildlife Strategy (2005c), (3) sage-grouse would be managed to maintain populations trends consistent with adjacent "control" populations, (4) through the use of BMPs, adaptive management, etc. management changes will be made if populations decline by 25 percent over a five year period, (5) siting surface disturbance proposals to meet objectives for sage-grouse habitat management within 1 mile of a lek (6) restrictions on new roads and utilities (either explicitly or through watershed-level resource analysis; (7) burying all powerlines in sage-grouse habitat, where feasible and (8) conservation measures described in the WMPP. As research and monitoring continued, BLM and partners might develop new COAs and BMPs to supplement those already contained in the WMPP and other BLM publications.

While Alternative F includes a phased development component that would limit the number of APDs approved each year, Alternative H would require POD development and approval be based on the four resource screens and watershed-level impact analysis so that the rate of APD approval is expected to be similar to that of Alternative F.

Alternative H would allow CBNG to occur, with strict application of COAs and monitoring of populations to with a goal of managing habitat to ensure populations remain consistent with adjacent control populations. In addition, even with the application of the best science, BMPs etc. population may be negatively impacted. Monitoring will focus on these changes and if sage-grouse populations decline by 25 percent or more over 5 years or if populations appear to be headed in this direction, BLM would implement changes in management designed to maintain sage-grouse populations at a level consistent with adjacent populations. Alternative H would start with more restrictions and increase restrictions if monitoring showed BMPs were unsuccessful at meeting the objectives of this alternative. Recent research (Holloran and Anderson 2004, Holloran 2005); and ongoing studies specific to CBNG development in the Powder River Basin indicate potential for declining local populations of sage-grouse unless large quality habitat areas are maintained that provide suitable habitat for all critical life cycle periods (i.e., brood rearing, breeding and wintering).

As noted previously, Alternative H has the following objectives: maintaining the connectivity of sage-grouse habitat within the PRB and adjacent regions, maintenance of source populations for repopulation of areas from which displacement may have occurred due to CBNG development and maintain sage-grouse habitat so that population trends follow the general magnitude of decline or increase as that occurs on the control leks.

Even with the possibility of a slower pace of development in crucial sage-grouse habitat under this alternative, there is a potential that sage-grouse may be displaced from some of the habitat before the impacts become evident in the monitoring data, which would reduce sage-grouse populations. However, the monitoring and adaptive management may limit the extent of decline and allow BLM to modify management to stabilize populations.

Consequently, effects of Alternative H on wildlife would be similar to Alternative F, except for sage-grouse and sagebrush obligate species.

General Effects to Wildlife

As with the other development alternatives, CBNG development and construction and use of related facilities (i.e., roads, pipelines and utility corridors) can cause numerous direct and indirect effects to wildlife. The primary effects include: (1) direct mortality (from crushing by construction equipment, collision with vehicles and collision with powerlines); (2) habitat loss, degradation (e.g., invasion of noxious weeds, changes in water quantity and quality) and fragmentation; (3) noise and visual disturbance; (4) increased legal and illegal hunting; and (5) barriers to dispersal and movement. Effects to individual species depend on extent, location and timing of the activity and sensitivity of the species, among other factors. Table 4-68 indicates the relative level of vulnerability of different representative types of wildlife to direct and indirect impacts.

As under Alternative F, the threshold component of Alternative H would limit the amount of impacted habitat on BLM-administered surface or on private surface overlaying federal minerals. BLM would manage disturbance in crucial habitats (e.g., crucial brood rearing/breeding/wintering habitat) where federal mineral ownership occurred. Crucial habitat for additional species, particularly Tier 1 species identified in the Montana Comprehensive Fish and Wildlife Strategy (MFWP 2005d), might be identified and existing crucial habitats modified based on additional habitat monitoring/surveys.

A requirement for each proposed POD would be to identify crucial habitat polygons during project implementation. Management might be modified if monitoring data indicated a change in wildlife species populations within crucial habitats on or adjacent to POD areas. The "adaptive management" feature (identified in Chapter 2 and expanded in the Wildlife Monitoring and Protection Plan in the Wildlife Appendix) would increase the BLM's ability to modify the threshold percentage, if needed, to reduce the magnitude and level of habitat impacts.

Tables 4-66, 4-68 and 4-70 provide quantitative information on acres of direct and indirect impacts under the development alternatives. Assuming full CBNG development, Alternative H would result in the direct disturbance of up to 59,045 acres, resulting from development of 18,225 wells, 6,662 miles of roads and 20,623 miles of pipeline and utility corridors (Table 4-66). Taken together, Tables 4-70 and 4-71 provide a range of expected indirect impacts from the development alternatives. In all cases, the tables indicate that the total acres of indirect impacts are the same under all action alternatives. In reality, acreages of indirect impacts from Alternative H are expected to be less, given the habitat and development thresholds that are part of this alternative. In addition, note that indirect effects from new utility lines, pipelines and roads would not be the same under each alternative. Specifically, Alternatives B, D, F and H would have fewer indirect impacts from utility lines, pipelines and roads, since these alternatives include more restrictions on their development than the other action alternatives.

Lower-intensity development, or no development, within the crucial sage-grouse habitat areas would further reduce the overall impacts to other species that occupy these habitat areas.

As with Alternatives E, F and G, PODs under Alternative H would be developed and approved using the programmatic guidance outlined in the WMPP, BMPs, adaptive management and the stipulations identified in this document. These PODs would include baseline inventories for sensitive wildlife and habitats in areas where such inventories have not been completed as well as certain broad landscape-level inventories. Operators would be required to submit plans demonstrating how their project design minimizes or mitigates impacts to surface resources and meets objectives for wildlife before exploration and approval of the APD. The WMPP would be a cooperative approach incorporating adaptive management principles to try to address impacts as they occur. Over the life of the CBNG project, monitoring and evaluation through area-specific WMPPs would offer some insight as to the effectiveness of management actions and therefore encourage adaptive strategies to address specific or unforeseen problems.

Species of Concern

The types of direct and indirect impacts would be similar to the other development alternatives and to those described in the "General Effects to Wildlife" section under Alternative H above. However, implementation of the sage-grouse population change threshold combined with the WMPP would reduce impacts of CBNG development for most sensitive species compared to Alternatives B, C, D and E. Fragmentation of natural populations, including sage-grouse; and dispersal, colonization and extinction patterns would be reduced under this alternative. As with Alternative F, Alternative H could include approximately 8,286 infiltration and evaporation ponds (if not limited by development thresholds) with each pond assumed to cover about five acres and serving as a potential source for West Nile virus. Measures to minimize the exploitation of the CBNG ponds by breeding mosquitoes are included in the WMPP and would be implemented under Alternative H.

Crow Reservation

Indirect impacts on the Crow Reservation would be similar to those described in general for Alternative H. Impacts would be reduced from federal CBNG wells by implementation of mitigation and monitoring requirements within 5 miles of the Reservation boundary.

Northern Cheyenne Reservation

Indirect impacts on the Northern Cheyenne Reservation would be similar to those described in general for the Crow Reservation

Conclusions

The types of direct, indirect, residual and cumulative impacts would be generally the same as those noted for the other development alternatives.

Given the threshold limits on development and the implementation of the WMPP, impacts to wildlife from habitat loss, wildlife disturbance and mortality are expected to be less than Alternatives B through E, and between Alternatives F and G.

All wildlife species would be impacted at some level by habitat changes caused by the replacement of predisturbance vegetation with a different composition of vegetation following reclamation after well abandonment, increased access through increased roads and other indirect effects. However, implementation of stipulations, the WMPP, development thresholds, crucial sage-grouse habitat area objectives and adaptive management would ensure species do not decline to the point they need protection of the ESA as a result of BLM approved actions. For federally-listed species, some effects may occur, but effects are not likely to be adverse. Note that the Biological Assessment (see the Wildlife Appendix) provides additional information on effects to federally-listed species.

Aquatic Resources

Wildlife (Aquatic Resources)
Fish species vary between watersheds within the FSEIS Planning Area from 8 in the Little Big Horn River to 47 in the Yellowstone River.
Special Status Aquatic Species: Pallid sturgeon, Blue sucker, Northern redbelly X Finescale dace, Paddlefish, Pearl dace, Sauger, sturgeon chub and Yellowstone cutthroat trout.

Alternative A
No Action (Existing CBNG Management)

- Minor short-term impacts on aquatic resources during CBNG exploration and production may result from increased sediment delivery and its effects on aquatic habitat and organisms, possible impedance of fish movements, potential for accidental spills of petroleum products and possibly increased fish harvest.
- Relatively minor long-term increases in river flow and TDS concentration from production water discharge would not be expected to impact aquatic resources.

- Conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges.
- Impacts from CBNG abandonment would be minor and subside over time.

Alternative B
CBNG Development with Emphasis on Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

- The same types of impacts described for Alternative A (No Action) would occur under Alternative B, except as noted in the following two bullets.
  - The scale of potential impacts associated with sediment delivery, fish movements, petroleum spills and fish harvest would be greater under Alternative B because of the development of over 18,000 CBNG wells across a much larger geographic area.
  - No CBNG production water would be discharged to surface drainages under Alternative B.
- Based on fish species, fisheries management policies, fisheries resource values and projected intensity of CBNG development, the drainages most sensitive to the effects of CBNG development would be the Lower Bighorn, Upper Tongue and Little Bighorn; then the Lower Tongue, Little Powder and Rosebud; followed by the Mizpah.
- The potential for affecting aquatic resources, particularly in sensitive drainages, would be less under Alternative B than under Alternatives C or D.

Alternative C
Emphasize CBNG Development

- The same types of impacts described for Alternative A would occur under Alternative C, but they would occur on a far greater scale because of the development of over 18,000 CBNG wells.
- A total of 0.67 billion cubic feet of untreated CBNG production water would be discharged to drainages each year. Resultant flow and TDS increases could potentially impact aquatic organisms, especially in smaller drainages during dry times of the year.
- Conditions of MPDES Permits would provide legally enforceable assurances preventing the degradation of water quality, aquatic resources and the beneficial uses of receiving waters.
- The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative C than under Alternatives B or D.

Alternative D
Encourage CBNG Exploration and Development While Maintaining Existing Land Uses

- The same types of impacts described for Alternative A would occur under Alternative D, but they would occur on a far greater scale because of the development of over 18,000 CBNG wells.
- The annual discharge of 2.24 billion cubic feet of treated CBNG production water through pipelines or constructed water courses and resultant flow increases could impact aquatic resources in smaller drainages during dry times of the year.
- The treatment of CBNG production water prior to its discharge would greatly reduce the potential for elevated TDS and salinity impacts on aquatic resources.

- MPDES Permits would provide legal assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected.
- The potential for affecting aquatic resources in the sensitive drainages would be greater under Alternative D than under Alternative B but less than under Alternative C.

Alternative E
CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

- The same types of impacts described for Alternative A would occur under Alternative E, but the impacts would occur on a far greater scale because of the development of over 18,000 CBNG wells.
- The potential for affecting aquatic resources would be greater under Alternative E than under Alternatives B or D but less than under Alternative C.
- Pipelines or constructed water courses and resultant flow increases could impact aquatic resources in smaller drainages during dry times of the year.
- About 2.24 billion cubic feet of CBNG production water managed through flexible options, but allows no degradation of water quality (including thermal criteria).
- The required Water Management Plans and MPDES Permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected.
- The potential for affecting aquatic resources in sensitive drainages would be greater than Alternatives B and D but less than under Alternative C.

Alternative F Phased Development Multiple Screens (High Range)
• The same types of impacts described for Alternative A would occur under Alternative F, but the impacts would occur on a far greater scale because of the development of over 18,000 CBNG wells. • The potential for affecting aquatic resources would be more than Alternatives B and G, similar to Alternatives D and E but less than under Alternative C. • About 2.24 billion cubic feet of CBNG production water managed through flexible management options, but limits the volume of untreated water discharged to surface waters. • MPDES Permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected. • Limits CBNG development and total disturbed habitat annually and by watershed. • Sequential and controlled development schedule, combined with watershed-level analysis, provides a framework for assessing potential impacts through a systematic monitoring program. • Incorporates Adaptive Management approach in the phased development process that uses the monitoring data.
Alternative G **Phased Development Multiple Screens (Low Range)**
• The approximate 6,500 CBNG wells are about 65 percent fewer than the other action alternatives, resulting in less overall impacts. • The effects on aquatic resources would be similar in nature to Alternative F, but substantially less than Alternative F. • About 0.78 billion cubic feet of CBNG production water managed through flexible management options, but limits the volume of untreated water discharged to surface waters. • MPDES Permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected. • Limits CBNG development and total disturbed habitat annually and by watershed. • Sequential and controlled development schedule, combined with watershed-level analysis, provides a framework for assessing potential impacts through a systematic monitoring program • Incorporates Adaptive Management approach in the phased development process that uses the monitoring data.
Alternative H Preferred Alternative - Multiple Screens
• The same types of impacts described for Alternative A would occur under Alternative H, but the impacts would occur on a far greater scale because of the development of over 18,000 CBNG wells. • The potential for affecting aquatic resources would be similar to Alternative F . • About 2.24 billion cubic feet of CBNG production water managed through flexible management options, but limits the volume of untreated water discharged to surface waters based on water quality monitoring. • MPDES Permits would provide assurances that water quality, aquatic resources and beneficial uses of receiving waters would be protected. • Unlike alternatives F and G, which set specific limits on the number of CBNG development by watershed, Alternative H uses water quality and quantity criteria to manage the number of CBNG wells in the various watersheds • Incorporates Adaptive Management approach in the development process that uses the monitoring data.

Assumptions

The BLM has identified numerous mitigation measures in Chapter 2 that would be implemented to avoid or minimize impacts on biological resources and hydrological features resulting from CBNG exploration, production and abandonment activities on BLM-administered surfaces. These measures are common to all of the alternatives being analyzed in this EIS and are derived from current BLM leasing stipulations (contained in Minerals Appendix, Table MIN-5), standard operating procedures and BMPs and State of Montana field orders. Several of the mitigation measures related to aquatic resources are briefly reviewed here for reader reference prior to discussing potential impacts and impacts that would be avoided or minimized, assuming the successful implementation of these mitigation measures.

A key mitigation measure that directly affects aquatic resources is that the Montana and Wyoming Water Quality Agreement, which is pending final approval, would preserve the current water quality in the Tongue River and prevent Wyoming operators from discharging poor quality production water into the Tongue River. Examples of other mitigation measures related to aquatic resources that are referenced in Chapter 2 and described in Table 4-67 of the Wildlife section include a prohibition on the surface occupancy or use of water bodies and streams, riparian areas and 100-year floodplains of major rivers, streams and water bodies. In addition, surface occupancy and use is prohibited within 1/4 mile of designated reservoirs with fisheries, to protect the fisheries and recreational values of reservoirs.

Specific mitigation measures are directed at protecting water quality and aquatic resources in drainages by controlling erosion and sediment delivery, particularly on steep slopes and during wet times of the year; minimizing the number of stream crossings;

reclaiming, reseeding and revegetating disturbed areas; and maintaining a Spill Prevention Control and Countermeasures (SPCC) Plan to deal with accidental spills and control storm water run-off. A number of mitigation measures that would be applied on a case-by-case basis, as needed, are described in Appendix Table MIN-5. Examples of mitigation measures associated with aquatic resources, some of which are directed at special status species, include considerations of the location and timing of stream crossings as they relate to fish spawning periods and habitat and the minimization or avoidance of in-channel activities to reduce the potential for habitat loss. The reader is referred to Chapter 2, Table 4-67 and Minerals Appendix, Table MIN-5 for a complete listing of all mitigation measures.

These mitigation measures would avoid some of the impacts that may otherwise occur on BLM-administered surfaces in the absence of such measures, but they do not apply to CBNG-related activities on non-BLM-administered surfaces and therefore would not avoid impacts on non-BLM-administered surfaces. The only management objective that applies to BLM-administered surfaces and lands subject to state regulations is the required placement of untreated waters from exploration activities in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

CBNG exploration, production and abandonment activities would potentially impact aquatic resources in a number of ways. The likelihood of these impacts occurring depends on the exact nature, location and timing of CBNG activities; the proximity of CBNG activities to water bodies and the presence of sensitive species and/or sensitive life stages in these water bodies; and the nature of mitigation measures that would be implemented to minimize, avoid, or mitigate the potential occurrence of impacts. The success of these actions requires and assumes a site-specific understanding of the resources to be protected and adherence to mitigation measures during CBNG activities. The assumptions stated in the Hydrological Resources section of this chapter also form a portion of the framework for analyzing potential impacts from CBNG activities on aquatic resources.

The discussion of impacts in the following text for the No Action Alternative first describes the types of impacts that would result from CBNG activities in the absence of mitigation measures. It then assesses the likelihood of such impacts occurring based on the nature and magnitude of CBNG activities, the proximity of those activities to aquatic resources and the rigor of mitigation measures that would be implemented on lands managed by BLM and on lands subject to state regulations. Conclusions address the residual impacts that would remain following the implementation of mitigation measures. Conclusions also address the cumulative impacts that would result from the residual impacts of CBNG development combined with the potential effects of other projects in the area.

Many of the same types of direct and indirect impacts on aquatic resources would occur regardless of the number of CBNG wells developed, although the magnitude of impact would vary. Many of the same types of mitigation measures also would be implemented. Therefore, the detailed discussions of types of impacts first presented for the No Action Alternative are referenced, as appropriate, in subsequent discussions of impacts for Alternatives B through H. The potentially greater magnitude and geographic extent of impacts on aquatic resources because of the substantially greater number of CBNG wells that would be developed under Alternatives B through H are discussed under those alternatives.

Impacts from Management Common to All Alternatives

Types of impacts on aquatic resources, including fish, aquatic invertebrates and their habitat, potentially resulting from CBNG development activities would be similar to those described for oil and gas exploration and development activities (MBOGC 1989). These include direct removal of habitat, habitat degradation from sedimentation, altered spawning and seasonal migration because of stream obstructions, direct loss of fish from accidental spills or pipeline ruptures releasing harmful substances, increased legal harvests of fish because of increased human access and reduced stream flows because of removing water for drilling activities. These potential types of impacts are common to all alternatives and are described further under Alternative A (the No Action Alternative). An additional impact on aquatic resources that would only occur under all alternatives except B is the potential for altered stream water quality and/or increased flows in those instances when production water is discharged to drainages. This impact also is described under the No Action Alternative. However, no impacts would result from conventional oil and gas activities because of protection of reservoirs on 1,844 acres.

Impacts from Management Specific to Each Alternative

Alternative A—No Action (Existing CBNG Management)

Numerous irrigation-related or naturally occurring dewatering problems that affect aquatic resources have been identified for drainages in the Billings RMP and Powder River RMP areas that would continue under the No Action Alternative. These problems were described in discussions of the affected environment and are not CBNG-related. In the Billings RMP area, these include periodic dewatering of portions of the Yellowstone River and downstream sections of the Clarks Fork and Bighorn rivers and chronic dewatering of the Boulder River, the upstream section of the Clarks Fork, portions of the Musselshell River and Careless Creek. In the Powder River RMP area, dewatering problems include periodic dewatering of the downstream section of the Tongue River and chronic dewatering of the Powder River. Dewatering indicates a reduction in streamflow, usually during the irrigation season (July through September), beyond the point where stream habitat is adequate for fish. Periodic dewatering indicates a crucial problem in drought or water-short years and chronic dewatering indicates a critical problem in virtually all years (Montana State Library NRIS 2005).

The two most common forms of water quality effects in the Billings RMP and Powder River RMP area drainages are from elevated sediment and salinity concentrations, primarily from non-point sources related to agricultural practices (MBOGC 1989). Levels of dissolved solids in drainages tend to increase proceeding downstream because of contributions from irrigation return flows, increased base flows that have been in contact with soil and rocks for long periods of time and effects of human activities. Water in intermittent and ephemeral drainages often is of poor quality because of the sudden and highly variable nature of discharge (snowmelt, intense rainstorms) that would result in elevated turbidity, dissolved solids and suspended sediment levels in these and in downstream perennial drainages (MBOGC 1989). These water quality conditions would likely continue under the No Action Alternative.

Fish populations and habitat in perennial and intermittent streams in the Billings RMP and Powder River RMP areas are impacted by drought, high temperatures, prolonged cold, heavy icing and flooding (BLM 1995). Pond habitat and fisheries in the RMP areas also would be affected by dry, low-water years when excessive water temperatures and reduced dissolved oxygen levels during summer would kill fish and by extended periods of ice and snow and subsequent oxygen depletion during winter that would kill fish (BLM 1995).

Previous studies have summarized the ways in which aquatic resources, including fish, aquatic invertebrates and their habitat, would potentially be impacted, either directly or indirectly, by CBNG activities (BLM 1992; USDI 2000; Regele and Stark 2000). Many of these impacts are the same as described for oil and gas exploration and development activities (MBOGC 1989). They include the following effects:

- Loss of aquatic and riparian habitat at stream crossings and near well sites
- Habitat degradation and loss from increased sediment delivery and sedimentation
- Altered spawning and seasonal migrations of fish because of stream obstructions
- Direct loss of fish and aquatic invertebrates from accidental spills, leakage and runoff of harmful substances into drainages
- Increased legal and possibly illegal harvests of fish because of increased human presence
- Altered water quality and increased stream flows from discharging CBNG production water into nearby drainages

While roads do not affect all species and ecosystems equally, the overall presence of roads is highly correlated with changes in species composition, population sizes and hydrologic and geomorphic processes that shape aquatic and riparian systems. All types of roads affect aquatic ecosystems in several general ways: (1) increased mortality from road construction, (2) alteration of the physical environment, (3) alteration of the chemical environment, (4) spread of exotic species and (5) increased alteration and use of habitats by humans (Trombulak and Frissell 2000).

Crossing streams and placing facilities such as culverts, bridges and cattle guards during the construction or upgrading of access roads to well sites would result in the localized loss of aquatic and riparian habitat. Depending on stream location and hydrology, drainages may provide year-round (perennial) or seasonal (intermittent or ephemeral) habitat for a variety of fish species and their life stages, including spawning, incubating, rearing, holding and over-wintering. Drainages also provide habitat for aquatic macro- and micro-invertebrates that are typically important fish foods, such as aquatic insects,

zooplankton, clams, snails and worms, as well as habitat for aquatic plants, including periphyton, phytoplankton and vascular macrophytes. Instream activities also would alter habitat characteristics such as water depth, velocity and habitat types that are important to native and introduced fish species as well as benthic invertebrates.

The loss of riparian habitat would be especially important in smaller drainages because of its many influences on the quality of aquatic habitat. Murphy and Meehan (1991) reported that riparian habitat can form a protective canopy that provides overhead cover for fish and moderates the extreme effects of air temperatures during summer (helps to cool streams) and winter (helps to insulate streams). Riparian habitat also helps reduce soil erosion and filters sediment before it enters streams, stabilizes streambanks and allows for the formation of undercut banks that provide cover for fish. In addition, riparian habitat contributes litter (nutrients and food for invertebrates) and woody debris (instream cover) to drainages and it provides habitat for insects that fall to the water's surface and are consumed by fish (Murphy and Meehan 1991). The loss of these riparian functions would result in impacts on aquatic resources.

Soil disturbance, erosion and runoff during CBNG activities would result in increased sediment delivery to streams and the degradation or loss of aquatic habitat. Examples of such activities include the construction, upgrading, use, maintenance and retirement of access roads; the installation of culverts, bridges and cattle guards at stream crossings; other instream activities such as fording streams; site preparation, well drilling and related onsite facilities; and the construction and placement of pipelines for gas delivery. The potential for erosion and runoff would be greatest where wet or moist soils on steep slopes with little or no vegetative cover have been compacted by heavy equipment (BLM 1992).

Increased sediment delivery to drainages would affect aquatic resources through the sedimentation of habitat and increased levels of turbidity and suspended sediment in the water column. Increased sedimentation would cause a reduction or elimination of stream bottom habitat used by aquatic insects such as caddisflies, mayflies and stoneflies; a subsequent reduction in aquatic insect abundance and diversity; a reduction in the permeability among interstitial spaces within spawning gravels that inhibits the flow of well-oxygenated water and the removal of metabolic wastes; a subsequent reduction in spawning success, hatching success and fish production; and a reduction in the interchange of surface and subsurface waters in the hyporheic (mixing) zone beneath the stream channel (Nelson et al. 1991; USDI 2000). Substantially increased sedimentation would eliminate or reduce the depths of pools that provide important year-round cover for juvenile, sub-adult and adult fish and would cause the premature siltation of beaver ponds, which often provide year-round habitat for trout (MBOGC 1989). If severe enough, increased sediment loads would cause the erosion and migration of stream channels (Chamberlin et al. 1991) and the degradation of aquatic and riparian habitat.

Elevated turbidity and suspended sediment levels caused by increased sediment delivery would have sublethal and acute effects on fish. Nelson et al. (1991) reported that suspended sediment concentrations of 1,200 mg/l can cause mortalities in under yearling salmonids, while suspended sediment concentrations as low as 100 mg/l up to 1,000 mg/l are sometimes associated with a general reduction in fish activity, impaired feeding, reduced growth, downstream displacement and decreased resistance to other environmental stressors. MBOGC (1989) reported fish and fish food production would be affected by the abrasive effects of very fine sediment on fish embryos and fry and on immature aquatic insects. In addition, very turbid waters would exhibit increased temperatures because of the water's capacity to retain more heat. This would affect those fish and invertebrate species with the most restrictive cold-water or cool-water thermal requirements.

The most severe aquatic impacts resulting from increased sediment delivery would be to trout, whitefish and grayling. These species have relatively narrow habitat requirements, including the need for clean, cold, well-oxygenated water and/or gravels for spawning, egg incubation, rearing and adult success (Bjornn and Reiser 1991). The MBOGC (1989) generally concluded that in Montana, increased sediment delivery would have a greater impact on aquatic resources in high-gradient mountain streams than in low-gradient prairie streams. Mountain streams typically support the very sensitive and highly valued species of salmonids, which are generally much less tolerant of increased sediment and turbidity levels than are the warm water fish species found in the lower-gradient prairie streams and rivers in Montana. The MBOGC (1989) also noted that the potential for impacts from sediment delivery to drainages may be greatest in mountainous terrain because roads and pipelines are typically constructed close to streams where slopes are less steep.

Fish spawning migrations and localized movements would be affected in the event of improper placement, misalignment, or construction of culverts and bridges. Improperly designed facilities would block fish passage directly or constrain fish movements by creating hydraulic barriers caused by excessive water

velocities or insufficient water depths. Furniss et al. (1991) reported that unless properly designed, stream crossings would be considered dams that are designed to fail, with subsequent impacts on fish passage and the sedimentation of habitat. Four aspects of culvert design, including diameter, length, slope and vertical drop to the water's surface, can potentially affect fish passage, especially of smaller fish. The MBOGC (1989) reported that perched culverts or small-diameter culverts with high water velocities effectively block trout spawning migrations. Bell (1986) stated that improperly designed culverts may preclude the passage of small fish and possibly discourage larger fish from attempting passage.

Accidental spills, leakage and runoff or leaching of petroleum products, drilling fluids stored in reserve pits and other potentially harmful substances such as CBNG production water (discussed further below) to surface water drainages may have acute and chronic effects on fish and their foods (BLM 1992; USDI 2000). These effects are influenced by the nature of the substance including its persistence and fate, volume of spill, distance from surface water and likelihood of entry, the volume and diluting ability of the receiving water and sensitivity of organisms exposed to the substance. Direct effects can include mortalities of aquatic organisms, while indirect effects may be exhibited through chemically induced changes in densities and community structures of aquatic organisms (Norris et al. 1991). Examples include alteration of environmental characteristics such as cover, food, or some other variable important to the well-being of fishes. Effects would be comparatively greater during low-flow than high-flow periods and in smaller rather than larger water bodies. The MBOGC (1989) concluded that the potential for impacts from accidental spills may be greatest in headwater mountain streams with relatively low flows because soils in such areas are often porous and runoff to streams is direct and rapid.

Increased human access because of new roads and increased human activity associated with CBNG exploration and production may result in increased legal and illegal harvest of fish from nearby drainages (MBOGC 1989). Besides angling mortalities of game species, legal fishing activities may result in the trampling of eggs and recently emerged fry from wading in streams and walking on or next to streambanks may cause increased bank erosion and habitat sedimentation.

As discussed in the *Hydrological Resources* section, surface water bodies should not be impacted directly from groundwater withdrawal due to the depth and confined nature of the individual coal seams. In the unlikely event that there is a very localized connection between a spring-fed stream and groundwater withdrawals, examples of resultant habitat modifications that could impact fish and invertebrates include reduced water depths; slower water velocities; fewer and/or shallower pools and riffles; increased water temperatures during summer; exposed stream channel bottom and stream banks; reduced habitat for spawning, rearing, holding and refugia; reduced riparian habitat quantity, quality and function; and reduced fish and invertebrate production.

Several examples illustrate the potential effects, or in the case of the proposed project, the anticipated absence of effects, of groundwater withdrawals on surface water hydrology and aquatic resources. The *Southern Ute DEIS* (USDI 2000) noted the potential for decreased surface water flows because of CBNG production water withdrawals from groundwater aquifers on the Southern Ute Reservation in New Mexico and Colorado. That analysis estimated that between 1,600 and 2,500 acre-feet of water may be lost from instream flows and concluded that this was not anticipated to impact fish habitat. This is equivalent to a 2.2 to 3.5 cfs reduction in instream flows spread evenly over a year. Under other circumstances and depending on the size of the drainage potentially affected, a flow reduction of about 3 cfs would have substantive effects on very small perennial and intermittent drainages, but negligible effects on very large perennial drainages. Studies also were conducted for the Deer Creek Coal Bed Methane Project, which is in the Tongue River watershed in the northwestern part of the Powder River Basin (BLM 2000a). Hydrologic analysis of the Deer Creek Project, like the hydrologic analysis in this EIS, indicated that because of the sealing effect of the overlying aquitards, water levels in shallow aquifer zones and in shallow wells in the Planning Area would not be impacted by water level drawdowns caused by CBNG well operations (BLM 2000a). The Deer Creek analysis concluded that flows and aquatic habitat in Planning Area drainages should not be depleted or aquatic habitat degraded. Similar findings were presented for studies of the Castle Rock Project, which concluded that cumulative impacts on the surface water resources of the exploration area, which include the Powder River and Pumpkin Creek, are expected to be minimal to nonexistent in the short term (BLM 2000b).

Aquatic resources would be affected by the discharge to surface waters of groundwaters that are withdrawn during CBNG production activities. The discharge of groundwaters would alter surface water quality and increase flows, potentially impacting aquatic habitat and biota. The effects of production water discharge would be most evident in smaller drainages during low-flow times of the year, particularly in those

drainages with low levels of TDS. The specific ionic constituents comprising TDS are also important determinants of a water body's effect on aquatic organisms. For purposes of comparison, fresh water usually has a salinity of less than 500 mg/l while sea water has an average salinity of 35,000 mg/l. The surface discharge and runoff of production water also would cause erosion of soils and even higher concentrations of solids. Examples of TDS concentrations in groundwater found in coal aquifers of the Powder River Basin were presented previously in the *Hydrological Resources* section of this document and ranged from 401 to 2,646 mg/l.

Based on the mitigation measures and assumptions described earlier, relatively few impacts on aquatic resources would be expected from exploration activities at 400 CBNG wells on BLM-administered lands under Alternative A. However, short-term impacts on aquatic resources resulting from CBNG exploration activities on BLM-administered lands would include increased sediment delivery to nearby drainages during runoff events. Fish passage would also be impeded if culverts or bridges are used to cross drainages and are inappropriately placed. In addition, there is the potential for the accidental spill or leakage and entry of petroleum products into drainages associated with vehicles using the access roads and present at exploration sites. Increased access and human presence during exploration activities also may result in some increased harvest of game fish. There would be no anticipated change in streamflow volumes by exploration activities since these activities would not discharge production waters into surface drainages. Any untreated waters from exploration would be placed in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

As noted in the earlier discussion of wildlife resources, nearly all of the mitigation measures for CBNG activities on BLM-administered surfaces do not apply to CBNG activities on non-BLM-administered surfaces (i.e., lands subject to state regulations). Therefore, the absence of mitigation measures that prohibit the occupancy or use of water bodies, floodplains and riparian areas on lands subject to state regulations increases the likelihood that exploration activities at 275 CBNG wells on state-regulated lands within or immediately adjacent to these habitats would have a greater potential for impacting aquatic resources than on BLM-managed lands. These impacts would be in addition to those described in the preceding text for exploration activities on BLM-administered surfaces. However, the magnitude of these impacts would probably still be minor because of the somewhat limited nature of exploration activities. There would continue to be the potential for increased sediment delivery, possible impedance of fish movements in streams, potential for accidental spills of petroleum products and possibly increased fish harvest. However, there would be no effect on stream flow volume. In addition, as noted for exploration activities on BLM-administered surfaces, there would be requirements for placing untreated exploration water in holding pits, tanks, or reservoirs, with no discharge to waters of the United States allowed.

The State of Montana has stressed the importance of protecting high-value recreational fish populations that occur in drainages in the CBNG Planning Area. It is expected that the state would not allow exploration activities to be conducted in a manner that would impact these highly valued fisheries. They include trout fisheries and populations of other important species of game fish, particularly in those drainages in each county that have been judged by the State of Montana to support a resource of national renown and to have outstanding, high, or substantial fisheries resource values.

Under the No Action Alternative, CBNG production would only occur on the CX Ranch, where there are no specific mitigation measures for CBNG production activities. Because of this, potential impacts from the development of 250 producing CBNG wells on the CX Ranch would generally include the same impacts that were described for exploration activities on lands subject to state regulations, although they would extend over a longer period of time. Discharge of production water from these wells would be regulated by the MDEQ via a MPDES permit, which would allow 1,600 gallons per minute (gpm) discharge into the upper Tongue River from up to 11 discharge points. During Water Year 2005, the average CBNG produced water discharge to the Tongue River in Montana was approximately 1,067 gpm upstream of the Tongue River Reservoir (MBMG 2005). However, current permits (as of February 2006) allow 3,300 to 4,200 gpm upstream of the reservoir (varying by season) and an additional 1,122 gpm downstream of the reservoir (see the *Hydrological Resources* section in Chapter 3).

The TDS concentration in CBNG-produced water from the CX Ranch is about 1,400 mg/l, while Regele and Stark (2000) reported the average TDS concentration for the Tongue River is 284 mg/l. The resultant TDS concentration from discharging 3.6 cfs (approximately 1,600 gpm) of production water (1,400 mg/l TDS) to the Tongue River with a flow of 39 cfs (284 mg/l TDS) would be 378 mg/l TDS. This represents a 94 mg/l increase in TDS over background levels, but it is still well below the TDS guideline of 1,000 mg/l associated with possible effects on fish. Resultant water temperatures would likely be similar to that of the

Tongue River upstream of the mixing zone because of the predominance of river flow. This would not be the case when there is very low or sometimes no background flow in the Tongue River, as is the case during critical drought periods. Under the very worst-case conditions, the only flow in the river would theoretically consist of CBNG produced water with a TDS concentration of approximately 1,400 mg/l that has been discharged to the river. While this TDS value would exceed the 1,000 mg/l TDS concentration associated with possible effects on aquatic organisms, it would be the only source of water in the drainage and probably provide at least some refuge for aquatic organisms until background flows return. Water temperatures may initially be somewhat cooler than would normally occur during low-flow periods, but they would likely increase proceeding downstream in response to local climatic conditions.

This same type of analysis can be done by evaluating the effect of produced water and the dilution effect of Tongue River water using bioassays and predictive modeling. However, the results of bioassays differ substantially from and show far fewer effects on aquatic organisms than suggested by predictive modeling. The Mount et al. (1997) model would predict that the produced water from the CX Ranch wells would be lethal to 100 percent of fathead minnows. Once the water is discharged to the Tongue River, the dilution would be such that there would be no increase in toxicity to fish in the river. The model would indicate that if there was no or very little dilution of this discharge by either flowing or standing river water, it would be toxic to fish and aquatic invertebrates.

Results of actual whole effluent toxicity testing using fathead minnows and a cladoceran (water flea), *Ceriodaphnia dubia*, showed far fewer or no mortalities than predictive modeling. A representative sample of effluent from Fidelity Exploration & Production Company coal bed natural gas wells that discharges to the Tongue River and of Tongue River receiving water collected immediately upstream of the effluent outfall were used in whole effluent toxicity testing. Acute toxicity tests (96 hours for fathead minnows and 48 hours for *Ceriodaphnia*) were conducted at Energy Laboratories, Inc. (2001) in Billings Montana, from March 22 through March 26, 2001, in accordance with Region VIII EPA guidelines. Six dilutions were used during whole effluent toxicity testing with percent effluent in each dilution at 0 percent (pure receiving water control), 12.5 percent, 25 percent, 50 percent, 75 percent and 100 percent (pure effluent). The effluent passed the 50 percent mortality test for both species tested, indicating there would be no mortalities at equal parts of effluent (or less) and receiving river water. At effluent levels of 75 and 100 percent, fathead minnow survival after 96 hours was 85 percent and 60 percent, respectively. *Ceriodaphnia* survival after 48 hours at effluent levels of 75 and 100 percent was 95 and 80 percent, respectively (Energy Laboratories, Inc. 2001). These test results generally indicate some mortalities of fish and insects could occur when the volume of effluent constitutes more than 50 percent of the flow in a drainage.

Experiments have shown that increased bicarbonate concentrations (sodium bicarbonate from CBNG produced water) appears to have greater toxicity to some fish than was previously estimated (Skarr et al 2005). Studies of newly hatched fathead minnows showed mortality when exposed to waters with bicarbonate concentrations greater than 400 mg/l. While white suckers show improved hatching and early survival rates at bicarbonate concentrations as high as 1,400 mg/l when compared to control groups. However, at higher concentrations (between 4,049 and 6,678 mg/l) the percent mortality of white suckers was as much as 50 percent (Skarr et al 2005). CBNG produced waters in the Tongue and Powder River watersheds have average bicarbonate concentrations of approximately 1,000 to 1,500 mg/l (Skarr, 2006).

In addition to untreated produced water discharge volumes, two additional permits were submitted to MDEQ for the discharge of treated water to the Tongue River (MBMG 2005) and subsequently approved. One of these permits would allow for discharge upstream of the Tongue River Reservoir (1,700 gpm) and the other for discharge downstream of the reservoir (1,122 gpm). The combined CBNG water discharges would result in a total of 7.6 cfs of increased flows to the river, or about 10 percent of the 7Q10 flow at Brandenburg Bridge.

The abandonment of exploratory and producing wells would have few, if any, direct or indirect impacts on aquatic resources. Activities that impact aquatic habitat and biota during CBNG exploration and production phases would cease with CBNG abandonment. Any associated long-term effects on aquatic resources from these discontinued activities, such as sediment delivery from roads, would gradually subside as disturbed areas are reclaimed.

Special Status Species

The federally endangered pallid sturgeon and one federal candidate species (Montana Arctic grayling) are present in portions of the Planning Area. Also present in portions of the Planning Area are seven BLM-sensitive and/or state fish species of special concern, including sturgeon chub, blue sucker, sauger, northern redbelly dace x finescale dace hybrid, paddlefish, pearl dace and Yellowstone cutthroat trout.

Distribution of these species was described in Chapter 3 discussions of the affected environment for aquatic resources. The affected environment for special status amphibians and aquatic dependent reptiles is discussed in the wildlife section of Chapter 3 and the potential impacts to these species from the project alternatives are presented in the wildlife section of Chapter 4.

Because of their scarcity or narrow habitat niche, these special status species may be somewhat more vulnerable to potential project effects than were described above for all aquatic resources. However, the potential for affecting any of the federally listed, candidate, significant concern, BLM-sensitive, or state species of concern would generally be similar to that described in the preceding text for other aquatic species and would either be low or absent. For example, all water from exploration activities would be captured in tanks and not discharged to rivers. In addition, conditions of MPDES Permits would provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges. Some impacts could potentially occur, however, during extreme low or no flow conditions. Release of adequate quality water from production may improve habitat that has been degraded through water withdrawals. The range and type of other potential effects discussed above for aquatic resources also apply to special status species since they are a subset of aquatic resources. Special status species could be minimally affected through construction of stream crossings, erosion generated by construction activities and effects of other activities discussed above for aquatic resources.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative A. However, regulations mentioned above related to aquatic resources would be under the jurisdiction of tribal laws and not state or federal laws. CBNG development on the Crow Reservation is expected to be very limited. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands and would occur on a much smaller scale than on BLM or State lands. If there were no CBNG development on tribal Lands, then there is expected to be minimal impacts on aquatic resources on the reservation. CBNG development in Wyoming could impact surface waters on the reservation and could have an effect on aquatic life.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative A. CBNG development on the Northern Cheyenne Reservation is expected to be very limited. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands and would occur on a much smaller scale than on BLM-administered or State lands. If there were no CBNG development on tribal Lands, then there is expected to be minimal impacts on aquatic resources on the reservation. CBNG development in Wyoming could impact surface waters on the reservation and could have an effect on aquatic life. However, the pending Montana and Wyoming Water Quality Agreement would preserve the current water quality in the Tongue River and prevent Wyoming operators from discharging poor quality production water into the Tongue River. The Tongue River borders the reservation on the east.

Conclusions

Relatively few residual impacts on aquatic resources, including the special status species, would be expected from exploration activities on BLM-managed lands. Some minor, short-term impacts on aquatic resources on BLM-administered surfaces may result from increased sediment delivery, possible impedance of fish movements in streams, potential for accidental spills of petroleum products and possibly increased fish harvest. Residual impacts on aquatic resources from exploration activities on lands subject to state regulations would be similar to these impacts, although possibly slightly greater in magnitude because of the lack of mitigation measures prohibiting surface occupancy or use of water bodies, floodplains, riparian areas and steep slopes. Expected impacts on aquatic resources on state-regulated lands would still be relatively minor because of the limited nature of exploration activities and their dispersed pattern over a large geographic area. Residual impacts from developing 250 CBNG wells on the CX Ranch would include the same potentially minor kinds of impacts that were described for exploration activities on lands subject to state regulations, although they would extend over a longer period of time. The effects of discharging production water from these wells to the upper Tongue River drainage basin would cause river flow to increase from about 39 cfs to 43 cfs and river TDS concentration to increase from 284 mg/l to 378 mg/l. These increases would not be expected to impact aquatic habitat or organisms in the Tongue River. In addition, the conditions of the MPDES Permit would provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges. Discharges of CBNG produced water during extreme drought conditions of no background flow (worst-case conditions) would probably provide

some refuge for aquatic organisms, even though TDS concentration would be approximately 1,400 mg/l and water temperatures would initially be cool but increase. There also could be some mortalities of aquatic organisms, as indicated by results of whole effluent toxicity WET testing, under these extreme conditions. The abandonment of CBNG wells would have few, if any, direct or indirect residual impacts on aquatic resources. Long-term effects on aquatic resources associated with discontinued activities, such as sediment delivery from roads, would subside as disturbed areas are reclaimed. Agency mitigation measures implemented during abandonment would reduce erosion potential, prevent water quality degradation, facilitate reclamation of disturbed lands and further reduce the potential for long-term impacts on aquatic resources, including special status species.

Cumulative Impacts

This assessment considers the potential cumulative impacts on aquatic resources resulting from the effects of the No Action Alternative together with the effects from five coal mines, two minerals/metals mines, five existing power plants, four oil and gas refineries, two manufacturing facilities and the proposed Tongue River Railroad that are present within the Planning Area. The greatest potential for impacts on aquatic resources from these other projects is probably from coal mines, both through the direct loss of habitat and the degradation of water quality. Surface water quality near coal mines is impacted by increased sediment load because of increased erosion during mining. This is mitigated by the use of sediment settling ponds and the vegetation of overburden and topsoil storage areas. The discharge of groundwater pumped from mine pits also may affect surface water quality and quantity, depending on the quality of groundwater within the mine vicinity and the quantity of groundwater discharged. Aquatic resources associated with nearby springs and surface streams within the area could be impacted by the lowering of water tables from mining activities. In some instances, mining activities impact aquatic resources by diverting streams or drainage areas that are within the area to be mined. Original topography, including stream channels and drainage areas, are restored during mine reclamation activities. Some of these same types of impacts also may occur at minerals/metals mines, but would be less likely to occur at the power plant, oil and gas refinery and manufacturing sites.

Other possible impacts on aquatic habitat and biota from these projects include sediment delivery from access roads located near drainages, loss of riparian habitat and function along streams and reduction in water-based recreational activities such as fishing with the loss of aquatic habitat. The nature of effects on aquatic resources from these activities would be similar to those described for potential impacts under the No Action Alternative for CBNG development. Most of these impacts would be limited in area given the generally localized nature of these other projects. Their effects are typically mitigated by following standard construction and operating procedures and BMPs and by implementing reclamation activities during or following project construction, operation and/or abandonment—the same as described for CBNG development under the proposed project. For these reasons, the effects from these other projects would not be expected to result in substantive cumulative impacts on aquatic resources potentially affected by CBNG development.

Regele and Stark (2000) discussed some of the possible biological issues associated with CBNG gas development in Montana, including the effects of pumping and discharging production water from CBNG wells into surface drainages. They reported that much of the groundwater being produced from more than 3,000 CBNG-producing wells in the Wyoming portion of the Powder River Basin is being discharged into rivers that flow directly into southeastern Montana. These include the Powder and Little Powder rivers and their tributaries. Some potential short-term and long-term CBNG developmental effects identified by Regele and Stark (2000) include decreased surface water availability in some areas because of groundwater pumping; increased surface water flows in areas receiving CBNG discharges in other areas; and water quality effects of CBNG development discharges on waters and biota receiving the CBNG discharges. However, Wyoming EISs and EAs found no decrease in surface water because of aquitards between production coals and surface waters.

The *Hydrological Resources* impact analysis presented in this chapter evaluated the potential cumulative effects of full-scale CBNG development and discharge of produced water to the Powder River Basin in Wyoming. That analysis recognized the substantial flow increases and associated hydrologic and water quality impacts that would occur in the Powder, Little Powder and Tongue rivers in Montana as a result of those discharges. Impacts on aquatic habitat and biota from that magnitude of discharge also would be substantial. The *Hydrological Resources* analysis noted, however, that the WYDEQ and MDEQ have pledged to maintain water quality in these three rivers and that surface water discharge permits limiting the quantity of CBNG-produced waters that would be discharged would mitigate impacts from Wyoming CBNG on Montana rivers. This action also would mitigate the potential for cumulative impacts on

aquatic resources from the effects of Wyoming CBNG on Montana rivers.

The proposed Tongue River Railroad could impact aquatic invertebrates and fish through habitat disturbance and water quality impacts, such as temporary increases in sediment loading and TSS, caused by construction of bridges and portions of the rail line adjacent to the Tongue River. Increases in TSS may temporarily increase downstream drift of aquatic invertebrates, resulting in lower invertebrate populations in the construction area and deter fish movement through the construction zone. Increased sediment loading may also cause the irritation of the gills of sensitive fish species. One spawning area for smallmouth bass may be temporarily or permanently lost and spawning habitat for northern pike may also be impacted. During operation of the railroad, impacts to aquatic resources may caused by loss of aquatic habitat from alteration of the flood plain, use of herbicides and fuel or other hazardous material spills. However, construction and operation of the railroad will be in accordance with all state and federal rules and regulations and will use mitigation measures and best management practices to minimize impacts to aquatic resources.

Alternative B—Emphasize Soil, Water, Air, Vegetation, Wildlife and Cultural Resources

Most but not all of the same types of impacts on aquatic resources described for CBNG activities under Alternative A (No Action Alternative) would occur under Alternative B. These impacts and some of their effects include the direct removal of aquatic and riparian habitat at stream crossings and near well sites, habitat degradation and loss from sedimentation, altered spawning and seasonal migration because of stream obstructions, direct loss of fish and aquatic invertebrates from accidental spills or pipeline ruptures releasing harmful substances and increased harvests of fish because of increased human access. The magnitude and geographic extent of these impacts would potentially be greater under Alternative B than Alternative A because of the activities associated with the development of an estimated 23,850 CBNG production wells and 2,650 CBNG dry holes. There would be an estimated 7,621 production wells and 847 dry holes on BLM-administered land, 8,849 production wells and 983 dry holes on state-regulated land, 7,200 production wells and 800 dry holes on tribal land and 180 production wells and 20 dry holes on USFS-administered land.

Impacts described under the No Action Alternative that are associated with the discharge of production water to drainages and resultant increases in stream flows and elevated levels of TDS and constituents would not occur under Alternative B. There would be a potential for the accidental spill, release, or seepage of production waters temporarily stored in holding ponds or tanks prior to their injection. However, as noted in the *Hydrological Resources* impact analysis, berms around these facilities would be designed to contain and prevent the accidental runoff to nearby drainages of stored production waters, which should minimize the potential for impacting aquatic habitat and resources.

The *Hydrological Resources* impact analysis indicates based on the estimated groundwater depletions, those watersheds that may experience the greatest CBNG development activity. The most active watersheds are projected to be the Little Bighorn and Lower Bighorn, Upper Tongue and Lower Tongue, Little Powder and Middle Powder, Mizpah and Rosebud, where an estimated 14 to 50 percent of the groundwater resource in the coal seams within a watershed would be depleted after 20 years. Even though few impacts on aquatic resources are projected under Alternative B, data on fish species present, fisheries management policies and fisheries resource values would be used to identify those watersheds and drainages that are probably most sensitive to the effects of CBNG development and should be monitored closely during CBNG activities. Based on these fisheries criteria, drainages probably most sensitive to the effects of CBNG development are the Lower Bighorn, Upper Tongue and Little Bighorn. The Lower Bighorn and Upper Tongue are managed as trout fisheries and have high fisheries resource values, while the Little Bighorn is managed for warm/cool water fish species and trout and has a moderate fisheries resource value. The Lower Tongue, Little Powder and Rosebud are probably less sensitive from a fisheries perspective, being managed as non-trout or undesignated fisheries, but they have high to substantial fisheries resource values. The Mizpah is probably the least sensitive of these drainages, being managed as a non-salmonid (warm water) fishery with a moderate to limited fisheries resource value.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative B would generally be similar to those described in the preceding text for aquatic resources under this alternative. Many of these effects also would be similar to those described under Alternative A. However, they would be greater in magnitude and extent because of considerably more production wells and would primarily result from construction-related activities. No production water would be discharged to drainages

under Alternative B and there would be no resultant potential for affecting special status species. The overall likelihood of affecting special status species would probably be low or absent, depending on species distribution. However, as noted for Alternative A, these species may be somewhat more vulnerable than the more commonly-occurring aquatic species because of their limited distribution, low abundance and/or narrow habitat requirements.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative B. CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 7,200 CBNG production wells to be developed on tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM-administered or State lands. If there were in fact no CBNG development on the Crow Reservation, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the tribe approves CBNG development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative B to minimize the potential for adjacent CBNG development to affect tribal aquatic resources.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative B. CBNG development on the Northern Cheyenne Reservation is expected to comprise a portion of the estimated 7,200 CBNG production wells to be developed on tribal lands. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands but would probably occur on a much smaller scale than on BLM or State lands. If there were no CBNG development on the Northern Cheyenne Reservation, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the tribe approves CBNG development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative B to minimize the potential for adjacent CBNG development to affect tribal aquatic resources.

Conclusions

The types of residual impacts that would persist for Alternative B are the same as described for Alternative A, with the following two exceptions. Impacts would occur on a far greater scale under Alternative B than Alternative A. Also, no CBNG-produced water would be discharged under Alternative B and there would be no potential for resultant residual impacts on aquatic resources, including special status species, from that particular activity.

When compared to Alternative A, there would be an increased risk for cumulative effects from CBNG activities associated with Alternative B, but the impacts would be less than Alternative C. In addition, the 1-mile-wide buffer around active coal mines under Alternative B would reduce the potential for cumulative groundwater drawdown impacts to result from coal mine projects.

Alternative C—Emphasize CBNG Development

Impacts on aquatic resources associated with Alternative C would include all of those CBNG-related impacts described for Alternatives A or B, but they would be greater in magnitude. The intensity and geographic extent of CBNG exploration, production and abandonment under Alternative C would be the same as described for Alternative B. However, Alternative C emphasizes CBNG exploration and development with minimal restrictions and it would disturb many more acres (101,000 acres short-term, 69,000 acres long-term) than Alternative B (80,000 acres short-term, 48,000 acres long-term). Alternative C contains the same set of mitigation measures as Alternative B, whose benefits were described earlier and which were listed in Chapter 2. However, unlike Alternative B, CBNG exploration and production water under Alternative C would be discharged, untreated, onto the ground's surface where it would subsequently enter surface water drainages. There would be no requirement for injecting CBNG production water into the ground, for treating water prior to its discharge, or for preparing a site-specific water management plan. Discharged CBNG water would be available for beneficial uses by industry, landowners, agriculture and for wildlife if of suitable quality.

The effects of increased TDS concentrations would probably be greater on the more sensitive species of salmonids in headwater mountain streams than on native fish species in prairie streams that have evolved in an environment of naturally higher TDS levels. In addition, sensitive species of salmonids and non-native warm water fish that have not evolved in highly saline water but that now reside in prairie streams also would be at risk. These species may be particularly vulnerable because TDS levels are generally already high in prairie streams, thereby increasing the potential for TDS-related impacts from CBNG production.

Regele and Stark (2000) discussed impacts on aquatic resources resulting from CBNG effects on drainage

hydrology and water quality that would probably have the greatest likelihood of occurring under Alternative C. Potential impacts from reduced surface water availability would probably be limited to the unlikely event of a localized connection between a spring-fed stream and groundwater withdrawals. This could possibly result in the reduction or loss of springs and flowing reaches of stream channels that provide habitat for native flora and fauna in southeastern Montana. Regele and Stark (2000) cited studies by the MFWP that recognized the importance of perennial and intermittent prairie streams in the life history of native fishes, by providing spawning and rearing habitat for mainstem fish species. The effects of increased flows from CBNG discharges would include channel erosion, soils and vegetation loss, increased sediment load and sedimentation and degraded water quality; these effects would directly and indirectly impact fish, amphibians, aquatic invertebrates and algae. Also, if great enough, increased TDS and salinity levels in streams receiving CBNG discharges would affect fish and aquatic invertebrates, especially those species not well adapted to high TDS levels, such as salmonids found in higher-elevation streams. Regele and Stark (2000) cited studies that showed TDS concentrations should not be increased above 1,200 micromhos if a water's "excellent biological health characteristics are to be preserved." The potential development of saline seeps down-gradient of CBNG holding ponds also would affect aquatic resources present in streams receiving these discharges. Regele and Stark (2000) cited the MFWP, which concluded that because of the limited fisheries habitat available in the arid environment of southeastern Montana, great care must be taken where there is a potential to degrade aquatic resources.

The *Hydrological Resources* impact analysis in this chapter estimated that 0.67 billion cubic feet of CBNG water would be discharged to the Montana portion of Powder River Basin drainages each year. This is equivalent to an additional, total year-round basin flow of 21 cfs and assumes a 70 percent conveyance loss prior to discharges reaching drainages. The *Hydrological Resources* impact analysis showed that resultant flow increases over base flows would average less than 1 percent in most of the Powder River Basin drainages. The largest percent base flow changes would occur in the Little Powder and Rosebud drainages, which are managed as non-trout, undesignated fisheries and have high or substantial fisheries resource values. Rosebud Creek has been proposed to be classified as a cold water fishery by the Northern Cheyenne Tribe. It supports northern pike and rainbow trout (FWS 1980). This additional volume of water in Powder River Basin drainages would not be expected to impact larger drainages or their water temperatures, but it would impact smaller perennial, intermittent and ephemeral drainages, especially if peak discharges of CBNG water to smaller drainages greatly exceed this annual average. Water quality would be impacted much more than water quantity from CBNG discharges because of the considerably higher TDS and constituent concentrations typically found in CBNG-produced water than in surface drainages. The *Wildlife* impact analysis in this chapter notes that the potential for impacting water quality by discharging CBNG production water with high salinity and sodicity would be greatest in smaller perennial and intermittent drainages during low-flow periods of the year. The effects of high TDS and constituent concentrations on aquatic organisms were discussed under Alternative A.

The temperature of the smaller perennial, intermittent and ephemeral receiving water bodies may also be affected by the increased groundwater discharge associated with this alternative. The resultant temperature change and potential for affecting aquatic resources would depend on a number of variables that would have to be determined on a site-specific basis, such as volume and temperature of production and receiving water, time of year, species present and their thermal tolerances and life history considerations. In the event of reduced water temperatures in receiving waters, any resultant adverse effects would tend to be greater in those systems or portions of systems (for example, downstream reaches) dominated by species with warm water thermal preferences.

Surface discharges of CBNG-produced water would be subject to MDEQ MPDES Permit requirements and limitations for discharge into identified watersheds. The volume of CBNG production water potentially discharged to the Powder River Basin drainages in Montana that were listed in the *Hydrological Resources* impact analysis has a greater potential for causing sediment, flow and water quality-related impacts on aquatic resources than the effects of Alternatives A or B. However, these effects would be within the range of acceptable limitations stipulated under the various MPDES Permits that would have to be issued under Alternative C. For this alternative to be viable, conditions of the MPDES permits must be able to provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges.

Special Status Species

The types of impacts and potential project effects on federally listed, candidate, significant concern, BLM-sensitive and state species of concern under Alternative C would generally be similar to those described in the

preceding text for aquatic resources under this alternative. Special status species would potentially be affected by changes in the quantity and quality of receiving waters from discharges of CBNG-production water, construction of stream crossings, erosion generated by construction activities and effects of other activities discussed above for aquatic resources. Since production water would not be held in tanks or improved in quality, that which reaches the Tongue, Little Powder and Powder rivers would likely have increased SAR values that could affect the quantity and quality of receiving waters, especially during low or no flow conditions, as well as food sources for special status species. One special status species possibly present in downstream reaches of several of these drainages and found in the Yellowstone River within the Powder River RMA that is potentially at risk is the federally-listed, endangered pallid sturgeon. Other special status species occupying similar habitat types in these particular waters also may be at risk. There also is the potential for affecting Montana Arctic grayling because of the nature of CBNG exploration and development activities that would occur under Alternative C. However, the likelihood of risk is probably low because grayling are generally found at relatively high, cold headwater locations within the Planning Area. Minimizing or avoiding activities in these specific types of areas to the extent possible would minimize the potential for affecting this species.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative C. CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 7,200 CBNG production wells to be developed on tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM-administered or State lands. If there were in fact no CBNG development on tribal lands, then there are expected to be minimal impacts on aquatic resources on the reservation. Unlike Alternative B, there would be no restrictive buffer zone around the reservation under Alternative C.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative C. CBNG development on the Northern Cheyenne Reservation is expected to comprise a portion of the estimated 7,200 CBNG production wells to be developed on tribal lands. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. Unlike Alternative B, there would be no restrictive buffer zone around the reservation under Alternative C.

Conclusions

The types of residual impacts that would persist for Alternative C are the same as described for Alternative A, but they would occur on a far greater scale. In addition, a large volume of CBNG-produced water would be discharged under Alternative C and there would be a potential for resultant residual impacts on aquatic habitat and organisms, including special status species, from that particular activity. One of the most noteworthy potential effects of this alternative on special status aquatic species would be possible risks to the endangered pallid sturgeon.

There would be an increased risk for cumulative effects from CBNG activities associated with Alternative C, when compared to all the other alternatives, because of the substantial number of wells that would be developed.

Unlike Alternative B, there would be no buffers around active coal mines or Indian reservations to minimize the potential for inter-related effects.

Alternative D—Encourage Exploration and Development While Maintaining Existing Land Uses

Impacts on aquatic resources associated with Alternative D would include all of those CBNG-related impacts described for Alternatives A and/or B, but they would be greater in magnitude. The intensity and geographic extent of CBNG exploration, production and abandonment and the acres of land disturbed in the short-term and long-term under Alternative D would be the same as described for Alternative B. However, Alternative D encourages CBNG development while maintaining existing land uses and protecting downstream water consumers. Alternative D, like Alternative B, contains the same set of mitigation measures designed to avoid, minimize, or mitigate the impacts of CBNG development activities on aquatic resources. However, unlike Alternative B, CBNG-produced water (depending on water quality) would be treated, prior to its discharge or storage in holding facilities, so that the effluent meets standards established by the MDEQ for downstream uses. Beneficial uses of produced water would be allowed and treatment would vary based on industrial, municipal, agricultural and wildlife uses. Treated, produced water would be discharged to drainages by

pipeline or constructed watercourses to avoid the potential for erosion and sediment-related impacts on aquatic resources. The treatment of produced water prior to its discharge to surface drainages through constructed facilities would greatly reduce the potential for elevated TDS, salinity and sodicity levels described for Alternative C.

The *Hydrological Resources* impact analysis estimated that 2.24 billion cubic feet of CBNG water would enter the Montana portion of Powder River Basin drainages each year. This is equivalent to an additional, total year-round basin flow of 71 cfs and assumes no conveyance losses because of the use of pipelines or constructed water courses to convey discharges. The *Hydrological Resources* impact analysis showed that resultant flow increases over base flows would average 1 percent in Powder River Basin drainages. The greatest increase in base flows (approximately by a factor of 4) would occur in the Little Powder and Rosebud drainages, which would impact aquatic habitat and organisms through the same mechanisms described under Alternative A. This volume of water would not be expected to impact larger drainages, but it would impact other smaller perennial, intermittent and ephemeral drainages, especially if peak discharges of CBNG water to smaller drainages greatly exceed this annual average. There would also be a potential for adverse temperature-related effects on warm water fish species if there is a reduction in receiving water temperature in these smaller drainages. Otherwise, water quality of these streams would not be impacted by discharged water since it would have been treated. As noted for Alternatives A, B and C, conditions of the MPDES permits issued under Alternative D must be able to provide legally enforceable assurances that water quality, aquatic resources and the beneficial uses of receiving waters would not be degraded by production water discharges.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative D would generally be similar to those described in the preceding text for aquatic resources under this alternative. Many of these effects also would be similar to those described under Alternatives A and B, except they could be greater in magnitude because of the discharge of treated production water to drainages under Alternative D. Special status species potentially most vulnerable to project-related effects would include those in smaller perennial and intermittent drainages within the Powder River Basin. The overall likelihood of affecting special status species would probably be low or absent, depending on species distribution. However, as noted for the other alternatives, special status species may be somewhat more vulnerable than the more commonly-occurring aquatic species because of their limited distribution, low abundance and/or narrow habitat requirements.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative D. CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 3,600 CBNG production wells to be developed on Crow tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM-administered or State lands. If there were no CBNG development on tribal lands, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the tribe approves CBNG development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative D to minimize the potential for adjacent CBNG development to affect tribal aquatic resources.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative D. CBNG development on the Northern Cheyenne Reservation is expected to comprise a portion of the estimated 3,600 CBNG production wells to be developed on Northern Cheyenne Tribal lands. To the extent that it does occur, impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM-administered or State lands. If there were no CBNG development on tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. Until the tribe approves CBNG development on the reservation, a 2-mile wide buffer zone around the reservation would be enforced under Alternative D to minimize the potential for adjacent CBNG development to affect tribal aquatic resources.

Conclusions

The types of residual impacts that would persist for Alternative D are the same as described for Alternative A, with the following two exceptions. Impacts would occur on a far greater scale under Alternative D than Alternative A. Also, CBNG production water discharged under Alternative D would be treated. Except for possible water temperature changes in smaller drainages, there would be no potential for residual water quality impacts on

aquatic resources, including special status species, from that particular activity.

When compared to Alternative A, there would be an increased risk for cumulative effects from CBNG activities associated with Alternative D, but the effects would be less than Alternative C (based on the total number of wells developed). In addition, the 1-mile-wide buffer around active coal mines and the 2-mile-wide buffer around reservations under Alternative D would reduce the potential for cumulative inter-related impacts to occur.

Alternative E—CBNG Exploration and Development with Enhanced Mitigation to Minimize Environmental Impacts While Maintaining Existing Land Uses

Impacts on aquatic resources associated with Alternative E would generally be comparable to the CBNG-related impacts described for Alternative B, which emphasizes the protection of natural and cultural resources. The number of CBNG wells developed would be the same as under Alternative B although more land would be disturbed under Alternative E in the short-term (99,000 acres) and the long-term (59,000 acres).The objective of Alternative E is to manage CBNG development in an environmentally sound manner while sustaining existing land uses. To meet this objective, Alternative E contains requirements designed to protect hydrologic resources by combining management options of CBNG-produced water so that no degradation of water quality, including thermal criteria, would be allowed in any watershed. These options include, but are not limited to, industrial, municipal, agricultural and wildlife beneficial uses, as well as injection, treatment, impoundment and discharge of CBNG water. CBNG operators would be required to develop a Water Management Plan as part of their overall Project Plan that describes how impacts on surface resources resulting from exploration and production activities would be minimized or mitigated and how a discharge (if proposed by the operator) could occur without damaging the watershed-in accordance with a required and approved MPDES Permit and MDEQ water quality laws. The Project Plan would be prepared in consultation with the affected Indian tribes, affected surface owners and other involved permitting agencies according to guidelines to be developed by the BLM and State of Montana.

The lack of transportation corridor requirements under Alternative E would result in greater surface disturbances and possibly increased sediment delivery to nearby drainages compared to Alternative B. However, because of the overall beneficial effect of protective measures, including the mitigation measures described earlier, relatively few impacts on aquatic resources would be expected under Alternative E. Aquatic resources in the same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also should be monitored closely during CBNG activities under Alternative E.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative E would generally be similar to those described in the preceding text for aquatic resources under this alternative. Requirements designed to protect hydrologic resources by combining management options of CBNG-produced water so that no degradation of water quality would be allowed in any watershed would benefit special status species. The lack of transportation corridor requirements under this alternative would result in comparatively greater surface disturbances than under Alternative B and possibly increased sediment delivery to nearby drainages. However, because of the overall beneficial effect of protective measures, relatively few impacts on special status species would be expected under Alternative E. The same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also should be monitored closely during CBNG activities under Alternative E.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative E. CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 3,600 CBNG production wells to be developed on Crow tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were no CBNG development on tribal lands, then there are expected to be minimal impacts on aquatic resources on the reservation. To determine potential impacts to the Crow Reservation from CBNG development on lands adjacent to the reservation, monitoring wells would be installed during the exploration phase on all BLM-administered oil and gas estates that adjoin reservation boundaries in Montana. If monitoring indicates drawdown would occur on the reservation, mitigation such as the operator providing a hydrologic barrier, communitization agreement, or spacing that would protect Indian minerals from drainage, would be required.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative E. CBNG development on the Northern Cheyenne Reservation could reach as high as an estimated 3,600 CBNG production wells. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were no CBNG development on tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. The same monitoring and mitigation procedures that were described for the Crow Reservation would be used on the Northern Cheyenne Reservation.

Conclusions

The types of residual impacts that would persist for Alternative E are similar to those for Alternative B. These impacts would be essentially the same as described for Alternative A, except that impacts would occur on a greater scale.

When compared to Alternative A, there would be an increased risk for cumulative effects from CBNG activities associated with Alternative E, but the effects would be less than Alternative C.

Alternative F—Phased Development Multiple Screens (High Range)

Impacts on aquatic resources associated with Alternative F (Phased Development) would generally be comparable to the CBNG-related impacts described for Alternatives B and E, which emphasize the protection of natural and cultural resources. The acres of land disturbed in the short term and long term under this alternative would be about the same as described for Alternative E.

The objective of Alternative F is to manage CBNG development in a phased or sequential manner within 4th Order watersheds, while maintaining limits on surface discharge of untreated produced water and surface area disturbances. To meet this objective, Alternative F is designed to protect hydrologic resources by establishing numerical limits on development rates within individual 4th Order watersheds while combining management options for CBNG-produced water to minimize water quality impacts. These produced water management options include, but are not limited to, industrial, municipal, agricultural and wildlife beneficial uses, as well as injection, treatment, impoundment and discharge of CBNG water. However, it is assumed that untreated CBNG discharge from state-permitted wells will exceed the limits established under Alternative F, so no untreated discharge is likely from BLM development under this alternative. For example, current discharge permits for untreated CBNG-produced water in the Tongue River drainage (including permits approved in 2006) is approximately equal to the total allowable untreated discharge volume for the entire watershed under Alternative F (10 percent of 7Q10 flow) (see the Hydrological Resources section in Chapter 3). This limitation is established to minimize impacts on surface resources resulting from exploration and production activities while adhering to the required and approved MPDES Permit stipulations and MDEQ water quality laws.

The possibility that transportation corridors would not be utilized fully (subject to watershed-level analysis) under Alternative F coupled with the increased handling or processing requirements of production water, would result in greater surface disturbances and possibly increased sediment delivery to nearby drainages compared to Alternative B. However, because of the protective measures and the gradual development rate within each 4th Order watershed, relatively few impacts on aquatic resources would be expected under Alternative F. Aquatic resources in the same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also would be monitored closely during CBNG activities under Alternative F using an adaptive management approach.

The phased development and adaptive management aspects of Alternative F are likely to provide a substantial level of protection for aquatic resources. There is considerable uncertainty regarding the specific effects of CBNG development activities on aquatic resources because of limited data, unknown influences of other environmental factors (e.g., drought conditions and other land use activities) and the variability and uncertainty concerning baseline (pre-development) conditions. Given these uncertainties, the systematic and gradual increases in CBNG development under Alternative F provide opportunities to monitor potential changes occurring in watersheds where CBNG development is occurring, as well as baseline conditions in watersheds scheduled for initial development activities.

While all of the action alternatives would likely be implemented in a sequential manner, similar to Alternative F, they do not include specific schedules for overall development or development within specific watersheds. The scheduling uncertainties of the other alternatives decrease the likelihood of obtaining accurate and quantifiable data concerning potential changes in aquatic resources as a result of

CBNG development. For example, Alternative F establishes a sequential order of development for the various watersheds, which is expected to limit the variability of other environmental factors that can increase the uncertainty of monitoring results.

The adaptive management process would use the information obtained from monitoring baseline conditions and conditions occurring during sequential CBNG development in a watershed to make appropriate adjustments to the extent or schedule for CBNG development in specific watersheds and the overall Planning Area.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative F would generally be similar to those described in the preceding text for aquatic resources under this alternative. Requirements designed to protect hydrologic resources by combining management options of CBNG-produced water to minimize water quality/quantity impacts in each watershed would protect special status aquatic species. The possibility that transportation corridors would not be utilized fully (subject to watershed-level analysis) under this alternative would result in comparatively greater surface disturbances than under Alternative B and possibly increased sediment delivery to nearby drainages. However, because of the protective measures, relatively few impacts on special status species would be expected under Alternative F. The same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also should be monitored closely during CBNG activities under Alternative F.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described in general for Alternative F. CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 3,600 CBNG production wells to be developed on Crow Tribal lands. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. However, it is assumed that CBNG development would also occur in a similar incremental fashion for watersheds on the reservation to maintain economic viability of development activities. In addition, any developments on the Crow Reservation would be included in the total number of allowable wells (either annually or cumulatively) for each 4th Order watershed. If there were no CBNG development on or upstream of tribal lands, then there are expected to be minimal impacts on aquatic resources on the reservation.

To determine potential impacts to the Crow Reservation from CBNG development within 5 miles of the reservation boundary in Montana, groundwater monitoring wells and analyses would be required to demonstrate the protection of Indian Trust Assets. If such protection could not be demonstrated, BLM would not approve the APD(s) in that area or would stop on-going development activities and shut in wells.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described in general for Alternative F. CBNG development on the Northern Cheyenne Reservation could reach as high as an estimated 3,600 CBNG production wells. To the extent that it does occur, potential impacts on aquatic resources would be similar to those described for private lands but would probably occur on a somewhat smaller scale than on BLM or State lands. If there were no CBNG development on tribal Lands, then there are expected to be minimal impacts on aquatic resources on the reservation. The same monitoring and mitigation procedures that were described for the Crow Reservation would be used on the Northern Cheyenne Reservation.

Conclusions

The types of residual impacts that would persist for Alternative F are similar to those for Alternative B. These impacts would be essentially the same as described for Alternative A, except that impacts would occur on a far greater scale. However, the annual and cumulative watershed development limits would result in gradual environmental changes (if changes occur as a result of CBNG development) and the adaptive management approach would likely result in less overall impacts than the other action alternatives.

As some untreated production water could be discharged under Alternative F, there would be a potential for resultant residual impacts on aquatic resources, including special status species. However, such impacts would be limited by the constraints of the MPDES permit and the cumulative limit of untreated discharge from all CBNG developments within each 4th Order watershed.

Cumulative effects from this activity would be similar to the effects described in Alternative A. However, an increased risk for cumulative effects would occur from CBNG activities associated with Alternative F, but would be less than Alternative C.

Alternative G—Phased Development Multiple Screens (Low Range)

Impacts on aquatic resources associated with Alternative G (Limited Phased Development) would be similar in nature to the CBNG-related impacts described for Alternative F, which emphasizes the same phased development approach. However, with 65 percent fewer wells developed under Alternative G, the overall impacts to aquatic resources are expected to be substantially lower than all the other alternatives.

The objective of Alternative G is the same as Alternative F, which is to manage CBNG development in a phased or sequential manner within 4th Order watersheds, while maintaining limits on surface discharge of untreated produced water and surface area disturbances. Thus, Alternative G is designed to protect hydrologic resources by establishing numerical limits on development rates within individual 4th Order watersheds, while combining management options for CBNG-produced water to minimize water quality impacts.

Like Alternative F, it is assumed that untreated CBNG discharge from state-permitted wells will exceed the limits established under Alternative G, so no untreated discharge is likely from BLM development under this alternative.

Also similar to Alternative F, transportation corridors might not be utilized fully under Alternative G. In addition, the increased handling or processing requirements of production water, could result in greater surface disturbances and possibly increased sediment delivery to nearby drainages on an average (per well) basis, compared to the other alternatives. However, because of the adaptive management approach, the gradual development rate and the reduced overall development within each 4th Order watershed, relatively few impacts on aquatic resources would be expected under Alternative G. Aquatic resources in the most sensitive watersheds would also be monitored closely under the adaptive management approach.

While there is considerable uncertainty regarding the specific effects of CBNG development on aquatic resources, the phased development and adaptive management aspects of Alternative G (along with the overall reduced development) are likely to provide substantial protection for aquatic resources.

While all of the action alternatives would also likely be implemented in a sequential manner, Alternatives F and G include specific schedules for overall development or development within specific watersheds. The scheduling increases the likelihood of obtaining accurate and quantifiable data concerning potential effects of CBNG development on aquatic resources because it facilitates adaptive management. The adaptive management process would use the information obtained during sequential CBNG development in a watershed to make appropriate adjustments to the extent or schedule of additional CBNG development in that watershed or the overall Planning Area.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative G would be similar in nature to Alternative F, although the overall effects are expected to be less because 65 percent fewer CBNG wells would be developed within each 4th Order watershed. The same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also should be monitored closely during CBNG activities under Alternative G.

Crow Reservation

Impacts on the Crow Reservation would be similar to those described for Alternative F. As in Alternative F, CBNG development on the Crow Reservation is expected to comprise a portion of the estimated 3,600 CBNG production wells to be developed on Crow Tribal lands. Any developments on the Crow Reservation would be included in the total number of allowable wells (either annually or cumulatively) for each 4th Order watershed. If there were no CBNG development on or upstream of tribal lands, then there are expected to be minimal impacts on aquatic resources on the reservation.

To determine potential impacts to the Crow Reservation from CBNG development within 5 miles of the reservation boundary in Montana, groundwater monitoring wells and analyses would be required to demonstrate the protection of Indian Trust Assets. If such protection could not be demonstrated, BLM would not approve the APD(s) in that area or would stop on-going development activities and shut in wells.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation. Total CBNG development on the Northern Cheyenne Reservation could reach as high as an estimated 3,600 CBNG production wells. The same monitoring and mitigation procedures that were described for the Crow Reservation would be used on the Northern Cheyenne Reservation.

Conclusions

The types of residual impacts that would persist for Alternative G are similar to those for Alternative F, except that impacts would occur on a smaller scale, due to the restricted overall development. Also, the annual and cumulative watershed development limits would result in gradual environmental changes (if changes occur as a result of CBNG development) and the adaptive management approach would likely result in less overall impacts than the other action alternatives.

As some untreated production water could be discharged under Alternative G, there would be a potential for resultant residual impacts on aquatic resources, including special status species. However, such impacts would be limited by the constraints of the MPDES permit and the cumulative limit of untreated discharge from all CBNG developments within each 4th Order watershed. Cumulative effects from this activity would be similar to the effects described in Alternative F, but less extensive.

Alternative H—Preferred Alternative - Multiple Screens

For aquatic resources, restrictions on CBNG development would likely be similar to Alternative F, as both alternatives assume a similar extent of CBNG development. While Alternative F uses restrictions on the overall and geographic extent of CBNG development to protect aquatic resources, Alternative H relies on specific screening criteria. Of the four screening criteria, the water resources criteria principally relates to aquatic resources. Thus, alternatives F and H provide mechanisms for controlling the cumulative effects of CBNG development within the CBNG project area, using an adaptive management approach. However, Alternative H would minimize the potential effects of CBNG development on aquatic resources by also relying on actual water quality monitoring data, rather than just limiting or gradually increasing CBNG development. Although monitoring and the actual rate of CBNG development would likely be similar for both of these alternatives, Alternative H uses specific monitoring criteria to facilitate the adaptive management decision-making process. However, because of the similarities between these two alternatives, their overall effects on aquatic resources would likely be similar. The type and magnitude of such effects are summarized below.

Unlike Alternative F, where it is assumed that untreated CBNG discharge from state-permitted wells would exceed the MPDES discharge limits and allow no additional untreated BLM discharges, Alternative H could result in additional BLM discharges so long as water quality criteria are not exceeded. This approach places more emphasis on specific water quality criteria, rather than relying on total discharge limitations to protect aquatic habitat. The water quality criteria under Alternative H would also encompass potential indirect effects of off-line reservoirs or surface applications of produced water on aquatic resources.

In addition to applying the water resources screening process, Alternative H would require operators to prepare Project PODs for well densities greater than 1 per 640 acres. This is expected to control the rate of CBNG development in specific geographic regions and provide a process for adaptive management review. While there is still considerable uncertainty regarding the specific effects of CBNG development on aquatic resources, the adaptive management and water quality monitoring aspects of Alternative H are likely to provide additional protection for aquatic resources compared to other alternatives.

While all of the action alternatives would likely be implemented in a sequential manner, Alternatives F, G and H include specific adaptive management criteria to control overall development, development rate, or development within specific watersheds. The scheduling and/or monitoring components increase the likelihood of obtaining accurate and quantifiable data concerning potential effects of CBNG development on aquatic resources, thereby facilitating the adaptive management process. This process would use the information obtained during sequential CBNG development in a watershed, or overall Planning Area, to make appropriate adjustments to the extent or schedule of additional CBNG development. As a result, few impacts on aquatic resources are expected under Alternative H, however, this alternative is expected to have more impacts on aquatic resources than Alternatives B and G.

The construction and use of CBNG-related facilities (i.e., roads, pipelines and utility corridors) can also cause direct and indirect effects to aquatic resources. The primary effects include direct loss of habitat (e.g., road crossing culverts), effects on water quantity and quality from changes in runoff characteristics and migration barriers or habitat fragmentation. The effects of these development-related facilities under Alternative H would be similar to Alternative F, as both alternatives have provisions to limit such facilities. However, the specific water quality monitoring requirements of Alternative H are expected to incorporate these potential additional effects on aquatic resources.

Special Status Species

The types of impacts and potential project effects on special status species under Alternative H would be similar to Alternative F, as both alternatives assume a similar extent of CBNG development and both include measures to control the rate of development. The same watersheds and drainages identified under Alternative B as being most sensitive to CBNG development also should be monitored closely during CBNG activities under Alternative H.

Crow Reservation

Impacts on the Crow Reservation would be similar to alternatives F and G, as CBNG development within 5 miles of the reservation boundary in Montana would require groundwater monitoring wells and analyses to demonstrate the protection of Indian Trust Assets. In addition, the maximum extent of CBNG development on the Crow Reservation would be the same for all these alternatives. If no CBNG development occurs on or upstream of tribal lands, minimal impacts to reservation aquatic resources are expected.

Northern Cheyenne Reservation

Impacts on the Northern Cheyenne Reservation would be similar to those described for the Crow Reservation. Total CBNG development on the Northern Cheyenne Reservation could reach as high as an estimated 3,600 CBNG production wells. The same monitoring and mitigation procedures that were described for the Crow Reservation would be used on the Northern Cheyenne Reservation.

Conclusions

The types of residual impacts that would persist for Alternative H are similar to those for Alternative F. Although Alternative H has no specific annual or cumulative watershed development limits, CBNG development is expected to be about the same as Alternative F. This is expected to result in gradual environmental changes (if changes occur as a result of CBNG development) and the monitoring and adaptive management aspects would likely result in less overall impacts than the other full-field development alternatives.

As some untreated production water could be discharged under Alternative H, there would be a potential for greater residual impacts on aquatic resources, including special status species. However, such impacts would be limited by the constraints of the MPDES permit and water quality monitoring requirements. Cumulative effects from this activity would also be similar to the effects described in Alternative F.

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